THURSDAY, FEBRUARY 4. 1886

ASTRONOMY DURING THE NINETEENTH CENTURY

A Popular History of Astronomy during the Nineteenth Century. By Agnes M. Clerke. (Edinburgh: Adam and Charles Black, 1885.)

WE have read this book with very great interest and with no little pleasure. The authoress (for this learned volume is indeed the product of a lady's pen) has modestly described her "History of Astronomy" as a *popular* work. We certainly hope that the book will be as popular as it deserves, and that it will be widely and extensively read. We think, however, that few men of science who use this book will think that it ought to be classed as a popular work in the ordinary acceptation. It might be more correctly described as a masterly exposition of the results of modern astronomy in those departments now usually characterised as physical.

Prof. Grant's "History of Astronomy," now more than thirty years old, treated of astronomy prior to that remarkable development of the science consequent on the invention of the spectroscope; Miss Clerke may thus be said to have resumed the subject from the point which Prof. Grant reached, and her present work is well worthy of a place beside Grant's volume in every astronomical library.

In the opening pages of the introduction Miss Clerke distinguishes the three great branches of the science of astronomy. The primary branch is that known as "observational," which involves the art of observing the returns and measuring the places of the heavenly bodies, but is not concerned with schemes for harmonising these facts into a compendious theory. The second kind of astronomy is that founded by Newton, and is most appropriately termed "gravitational." It seeks to account for the main facts of astronomy, in so far as the movements of the bodies are concerned, by the operation of the law of gravitation. The third branch is that which Miss Clerke terms "physical and descriptive." This branch of astronomy embraces the detailed study of the features of the different celestial bodies, and also the examination of their actual character and chemical composition. The two first branches are the older and better-known parts of astronomy. It is in the third branch that the great developments of modern times have taken place. It is especially in this department that Miss Clerke's work will be found invaluable as giving a succinct and accurate summary of our knowledge.

The work is divided naturally into two portions. The first part describes the progress of astronomy during the first half of the nineteenth century. It opens with an account of the career of Sir W. Herschel and his discoveries. In subsequent chapters of the first part we have the account of the memorable achievements of Bessel and Struve in sidereal astronomy. We have also a useful sketch of the earlier observations on and theories with regard to the structure of the sun; the discovery of the minor planets; the development of the cometary discoveries so far as the laws of their motions are concerned; and an account of the instrumental advances up to the time of the great Rosse reflector.

It is, however, in the second part, on "The Recent Progress of Astronomy," that Miss Clerke has found a new field, which she has occupied with great success. The earlier chapters of the second part relate to the foundations of astronomical physics. There is an admirable account of the state of our knowledge with respect to sunspots, and of the results obtained from recent eclipses. The spectroscopic work on the sun is discussed in an able chapter, while the researches on the great constant of the universe—the sun's distance—fitly occupy another. Then we have an account of the recent discoveries with respect to the planets and their satellites, and of the theory of planetary evolution. Chapters X. and XI., on comets, are especially good, and the spectroscopic labours on stars and nebulæ are also well described. A chapter on the methods of research concludes a volume of 468 pages. The photographic and spectroscopic work is virtually the theme of this book, and any one who desires to learn what has been done by Huggins and Lockyer, or by Young, or Janssen, or Vogel, will find full and accurate information. An index is provided which might, however, have been a little more extended with advantage.

At nearly every point Miss Clerke is careful to quote the references to the original authorities: this is indeed so characteristic a feature in the work that it would be valuable for these references alone, though in saying this we do not imply the slightest disrespect to Miss Clerke's able epitome of the results of each paper she has quoted. Many years of labour must have been required for the production of this work, for Miss Clerke has evidently studied with elaborate care the original writings on each subject.

So far as we have seen Miss Clerke does not appear to have been herself an observer of the heavens, and once or twice remarks occur which would hardly have been made by one who is familiar with astronomy in its practical sense. We are told, for instance, on page 103, that Bessel when a boy, could see the components of ϵ Lyræ apart with the unaided eye; no doubt he could, but the remark would hardly have been made by one who knew that everybody with tolerable vision can do the same.

In some few places we think that it would have been better to have allowed vague old speculations to pass into oblivion than to furbish them up once again; what, for instance, is the advantage of reproducing Wright's doctrines about the Milky Way, or the astronomical theories of Kant? No astronomy is worth anything which is not grounded on accurate observation or rigid calculation. The "Central Sun" rubbish ought never to have again been printed. We have however but few criticisms to offer on a work so thorough and so carefully written. Miss Clerke has expressly disclaimed any intention of discussing the more abstract mathematical researches relating to astronomy; one of the few exceptions is to be found in a description of Prof. George Darwin's now celebrated theory of tidal evolution; the account here given is both interesting and accurate so far as it goes, but mathematicians do not like such expressions as "wasting its momentum as heat dissipated through space" (p. 316).

The literary style of Miss Clerke's work is especially

admirable; a brief sentence is frequently found to contain an accurate and vigorous expression of an elaborate point. On page 3 we are told that "observation is the pitiless critic of theory." We are told that the probability of 61 Cygni forming a connected pair is actually greater than the chance of the sun rising to-morrow morning. We read of inconspicuous minor planets being difficult to detect "in the majestic disguise of a distant sun." We are told how Prof. Adams would not "take any steps to obtain a publicity which he was more anxious to merit than to secure." In referring to the same event, Miss Clerke describes how Lalande narrowly escaped the accidental discovery of Neptune, and adds: "An immortality which he would have been the last to despise hung in the balance; the feather-weight of his carelessness, however, kicked the beam." In speaking of the moon and the possible variations of lunar objects, Miss Clerke says: "A change always seems to the inquisitive intellect of man like a breach in the defences of Nature's secrets, through which it may hope to make its way to the citadel." There are charming bits of biography through the book: as of Olbers, who became a mathematician because he was an astronomer; of Encke, who became an astronomer because he was a mathematician; or of Schwabe, who, seeking his father's asses, found a kingdom.

There are, however, some few omissions, for which we hope in a future edition room will be made. We should have an account of Brünnow's work on stellar parallax. We think also that a history of modern researches on double-stars should include a notice of Dembowski's most elaborate observations; while the labours of Doberck deserve notice, as we owe to this indefatigable astronomer the greater part of our knowledge of the binary-star orbits. Miss Clerke has, however, fully appreciated the splendid work of S. W. Burnham, who has in ten years discovered 1000 double-stars. Those who are aware of the magnificent labours of Prof. Rowland, of Baltimore, on the solar spectrum will be disappointed in not finding some reference in a work of this kind. It must, however, be admitted that a complete account of Prof. Rowland's work has not yet been published.

Miss Clerke's most admirable work fills a widely-felt want. The progress of spectroscopy has been recently so rapid that it was often difficult to find out what was known and what was unknown. It is here that Miss Clerke renders an assistance that every astronomer must appreciate. He can in this volume obtain a vivid and accurate summary of what has been done, or, if he prefers to read the original memoirs, he will be directed where to find them. The work has been most skilfully and faithfully executed, and we heartily recommend it to every one who is interested in the noblest of the sciences.

ROBERT S. BALL

CRANIOGRAPHY

Eine exacte Methode der Craniographie. Von Dr. C. Rieger. (Jena: Verlag von G. Fischer, 1885.)

THIS work contains the description of a method of craniography employed by the author for upwards of five years for obtaining exact geometrical drawings from the skull or from the head of the living person. The first question dealt with by the author is the plane of orientation of the skull to be adopted. He discards all those which have for their aim the placing of the skull or head in the position natural to man, namely, with the axis of vision as nearly as possible horizontal, and prefers a plane determined by anatomical considerations alone. After studying different anatomical points on the skull for this purpose, he came to the conclusion that the most suitable is a plane running along the base of the cerebrum, extending in front from the angle which the horizontal and vertical portions of the frontal bone make internally with one another to the upper border of the sulcus transversus of the occipital bone, the attachment line of the tentorium cerebelli. This plane placed horizontally is the orientation of the skull adopted by the author. He then proceeds to consider the question of how far the proposed horizontal corresponds to the base of the cerebrum; and secondly, whether it can be determined on the periphery of the unopened skull or the head of the living. Sections of the skull show that the plane corresponds fairly in front with the base of the cerebrum, but posteriorly there is an elevation of the anterior part of the cerebellum and ganglia, so that it does not follow exactly the line of the cerebellum, though roughly it may be said to do so. The determination of the points on the exterior which correspond respectively to the anterior and posterior ends of the plane or long axis of the skull is of greater importance. The anterior point is defined as that point where a line joining the upper borders of the orbits crosses the median line of the skull. The posterior point is more difficult to define, as here several anatomical questions are involved, such as the relation of the protuberantia externa to the interna, and whether the latter corresponds to a fixed point externally. From his investigations the author found that the position of the attachment of the tentorium on which the posterior end of the cerebrum rests cannot be exactly determined in the unopened head or skull, but the variations in position of the external and internal protuberances in comparison to the whole cranial space are so small that the error is infinitesimal. Both in the skull and in the living the termination externally and posteriorly of the plane may be taken as that point where the linea semicircularis superior intersects the protuberantia occipitalis externa in the middle line, or in the living immediately above the line of attachment of the muscles. Having determined these points, he proceeds to show that the outlines of the dimensions of the skull in relation to this plane can be taken only with the assistance of ordinates standing at right angles to one another. He has satisfied himself that it is necessary to have complete outlines of the whole of the curves, and not only the greatest dimensions, so that a model of the skull from which they are taken can be at once apparent. Only a few of the most important curves require to be taken in every case: these are a curve of the ground or horizontal plane, of the median plane, and a third transversely over the cranium in the plane of the external auditory meatus.

The method of obtaining the curves is as follows:—Two threads are tied in the centre so as to form a cross; each end is weighted with lead. The knot is placed in

the middle line on the crown of the head, so that it lies as nearly as possible on the shortest line between the nasion and the protuberantia occipitalis. It is of no consequence whether the knot of the thread lies a little forward or backward. Two arms of the thread are placed anteriorly and posteriorly, one over the nasion, the other over the occiput. The other two are placed transversely across the skull, so that they correspond to the anterior border of each auditory meatus.

The next thing is to fix the points at which the cross-threads cut the line of the ground-plane. For this purpose an elastic band is placed around the skull so that it lies on the anatomical points indicating the anterior and posterior ends of the long axis, and in a straight curve round the skull between these points. When the skull is placed with this line horizontal, we obtain the ground or horizontal plane from which the other curves are to be taken. For the purpose of recording the curves millimetre paper is used, and the principal axes of the skull marked off on it. The long or median axis is measured with calipers. The total length is divided by two, and each half is measured off in a straight line on the millimetre paper from a centre. By a similar process the transverse axis of the skull is obtained at the points where the transverse threads cut the horizontal plane. A rectangular figure is then drawn through each of these points, indicating the length and breadth of the cranium. This forms a boundary-line for the tracing. In order to determine at what point the transverse axis intersects the longitudinal axis in the skull, it is necessary to find out how far behind the mid-point of the long axis the transverse axis is situated. This is done by measuring the distance from the anterior point on the skull to the point where the transverse and horizontal planes intersect at the anterior border of each auditory meatus (which we shall call the "ear-point"), and then marking it off on the millimetre paper, taking as a starting-point the anterior end of the long axis. The true zero or middle point of the skull will be that at which the transverse axis intersects the long axis. This middle point may bear different relations to the middle point of the long axis in that it may coincide with it or be behind it. Whatever may be its relations to the long axis, the transverse axis must be placed on the paper, so that it crosses the centre of the rectangular figure. If the middle point is behind the centre of the long axis, the anterior end of that line will project a corresponding distance beyond the anterior boundary of the figure, while its posterior end will fall at a corresponding distance within it. This will show the projection of the skull forwards and backwards in relation to the anterior borders of the auditory meatus. Should the base of the skull or the ground plane not be symmetrical, the axis of length and that of breadth will not be at right angles to each other, but more or less oblique. Having fixed the position of the axes with respect to the rectangular figure, the horizontal curve is drawn on the paper in four segments in the following way:—A flexible, but absolutely inelastic piece of lead wire is laid on the skull, with its one end corresponding to the right ear-point; it is moulded to the skull, along the horizontal line, to the anterior point in front, then from the left ear-point to the anterior point, and finally from each ear-point to the posterior point. The segments are then carefully placed on the paper with the points all coinciding to those on the marked quadrilateral, and, with a pencil, a tracing on the paper is made along the inner side of the lead wire. In this way the outlines of several skulls can be superimposed; the transverse and longitudinal axes of all the skulls must, however, be made to coincide.

The median longitudinal curve is taken from the end points of the long axis in two pieces, as it is not possible to take it all at once, and the knot on the cross-threads is utilised for determining a point on the curve from which each segment can be taken. Its position is defined on the paper in the following manner:—With a pair of compasses the distance from the anterior end point to the knot is measured on the skull and then laid off on the paper backwards, starting at the anterior end of the long axis line. The distance from each side point to the knot is measured and laid off on the paper so that the two lines converge and meet in front. The distance of the point of union to the zero will represent the sagittal height of the skull. From the anterior end of the long axis a segment having a radius equal to the distance from the side point to the knot is marked off with the compasses on the paper, and another segment is likewise marked off from the zero point with a radius equal to the distance between the zero point and that at which the two side lines meet. Where the two segments intersect, we have a fixed point which will represent the position of the knot. The accuracy of the point so determined may be further verified by a similar process from the posterior end of the axis line. The lead wire is then laid along the curve, first the one half and then the other, and on being placed on paper is traced with a pencil.

Curves of the transverse diameters of the calvaria are taken in a similar manner.

The method is one which requires a considerable amount of care and time. It has the advantage of not requiring any complicated apparatus, but whether its results are equally reliable and compensate for the time required in the manipulation is possibly an open question. For laboratory work we are inclined to think that the stereograph of Broca will prove much more useful, and repay its cost in the rapidity and accuracy with which all the tracings described in Dr. Rieger's monograph can be made. Moreover, with the stereograph, drawings of the face can be made which are not practicable with the graphic method of Rieger.

The plane of orientation proposed by Rieger cannot be considered quite satisfactory, owing to the difficulty of determining accurately its posterior end. A plane of orientation of a purely anatomical character, which we have frequently used, is that with the basio-nasial line horizontal, it being the axis on which both the brain-case proper and the facial portion of the skull are developed. These anatomical planes have the disadvantage of placing the skull in an unnatural position, but are of the greatest use in comparing outlines of the side view of different skulls. For general purposes, however, we have found the alveolo-condylar plane of orientation to be the most useful.

J. G. GARSON

OUR BOOK SHELF

Studies from the Laboratory of Physiological Chemistry of the Sheffield Scientific School of Yale College for 1884-85. Edited by Prof. R. H. Chittenden, Ph.D. (New Haven, 1885.)

THIS volume of some 200 pages is a reprint from volumes vi. and vii. of the *Transactions* of the Connecticut Academy, which were published between March and November of 1885. It contains eleven more or less important physiological memoirs, the result of work done in the Sheffield Scientific School of Yale College by Prof. Chittenden and his colleagues. The first memoir investigates the diastatic action of saliva as modified by various conditions, studied quantitatively, the joint author being Dr. Herbert Smith. The second is on the amylotic action of diastase of malt as modified by various conditions studied quantitatively, the joint author being Dr. Cummins. Diastase taken into the stomach must sooner or later be completely destroyed by either the free acid or the large percentage of acid proteids; but in the first stage of digestion, in the absence of free acids and under the protecting influence of proteid matter, the conversion of starch into sugar may still go on, though soon destined to feel the effects of the gradually increasing percentage of combined acid. The third memoir is by the Editor and Dr. Painter, on the influence of certain therapeutic and toxic agents on the amylotic action of saliva. The substances selected for study, besides those noted for therapeutic or toxic power, were also those possessed of antiseptic properties. Mercuric chloride, which acts so powerfully as a germicide, acts even more energetically on the organised ferment of saliva. It is interesting to find that air, oxygen, and carbonic acid all stimulate the amylotic ferment, and this approximately in proportion to the extent in which they are present in the natural secretion; while of the reducing gases, hydrogen retards and hydrogen sulphate stimulates. In a fourth memoir, by the Editor and S. E. Allen, the subject is the influence of various inorganic and alkaloid salts on the proteolytic action of pepsin-hydrochloric acid. In this the comparative influence on gastric digestion of various metallic salts well known as poisons or therapeutic agents has been studied, and some experiments on some alkaloid salts are added. The subject of the influence of temperature on the relative amylotic action of saliva and the diastase of malt is treated of by the Editor and Dr. W. E. Martin. The influence of various therapeutic and toxic substances on the proteolytic action of the pancreatic ferment, and on the influence of bile, bile salts, and bile acids on amylotic and proteolytic action are investigated in two memoirs by the Editor and Dr. Cummins. There is a very interesting, and, from a medico-legal point of view, important memoir on the absorption of arsenic by the brain tissues, by the Editor and Dr. Herbert E. Smith. Two memoirs on the influence of potassium and ammonium bromides, and on cinchonidine sulphate on metabolism, are by the Editor and Dr. W. Culbert, and the Editor and Dr. Henry Whitehouse; while a memoir on the *post-mortem* formation of sugar in the liver in the presence of peptones, by the Editor and Dr. Alex. Lambert, concludes a volume which in many ways reflects great credit on the work done at Yale College, and shows an intimate knowledge of the labours in the same direction of the authors' fellow-workmen in Europe.

Catalogue of the Lizards in the British Museum (*Natural History*). 2nd Edition. By George Albert Boulenger. Vol. II.

THE rapid progress made with this important Catalogue shows an amount of energy on which the authorities of the British Museum and herpetologists generally may be congratulated. The first volume appeared early in 1885, and was noticed in NATURE for May 21 (vol. xxxii. p. 49); the second volume was issued before the conclusion of the year.

This volume contains the following families of lizards: Iguanidæ, with 293 species; Xenosauridæ, with 1; Zonuridæ, 14; Anguidæ, 44; Anniellidæ, 2; Helodermatidæ, 3; Varanidæ, 27; Xantusiidæ, 4; Teiidæ, 108; and Amphisbænidæ, 65; or a total of 561 species, distributed amongst 115 genera. The number of species is consequently rather greater than in the first volume, which contained descriptions of 490. In the present as in the preceding volume several genera proposed by previous writers are united into larger generic groups: thus in the Varanidæ only one genus, Varanus, is recognised in place of the seven into which the family was divided in Dr. Gray's Catalogue of 1845. Five new genera are proposed—three in the Iguanidæ and two in the Teiidæ. The construction of one of the names proposed, Enyalioides, is, however, unfortunate, as the termination, that of an adjective, is objected to by many naturalists, and there is consequently the risk of another term being proposed.

Nearly all the Iguanidæ and all the Teiidæ are American, and as these two families contain between them 401 species out of the total number described in the volume there is a great preponderance of types peculiar to the New World. Two of the exceptions to the prevailing American distribution in the case of the Iguanidæ, the genera Chalarodon and Hoplurus, are peculiar to Madagascar, although no species of the family has been discovered in Africa.

The lithographic plates attached to both this and the previous volume are excellent, and the figures of lizards, even if not quite so life-like as the highly artistic drawings of the late Mr. Ford, are far superior to the illustrations usually found in works on Reptilia. W. T. B.

Physikalische Krystallographie und Einleitung in die krystallographische Kenntniss der wichtigeren Substanzen. Von P. Groth. 2nd Edition. (Leipzig: Wilhelm Engelmann, 1885.)

THIS is the most satisfactory work of its kind which has been published in any language. In a very simple way the chemist is made to comprehend the mysteries of geometrical crystallography, the physicist is taught how intimately optical and other physical characters are related to crystalline form, while to the microscopical petrographer is presented a careful explanation of the principles upon which all his determinations must be based. We are glad to see that in this edition the simple notation of the late Prof. Miller, of Cambridge, reigns almost supreme; doubtless, it will soon succeed in driving its unpronounceable rivals completely from the field, to the relief of every student. Stereographic projection too takes a very prominent place. In the present edition the work has been increased by 180 pages, most of which are given to the chapter descriptive of the instruments: there are as many as 631 woodcuts. We wish this edition all the success it deserves.

The Rudiments of Mineralogy. By Alexander Ramsay, F.G.S., &c. Third Edition. (London: Crosby Lockwood & Co., 1885.)

MR. RAMSAY is far from being a master of his subject. We cannot imagine what advantage the elementary student, for whom the book is intended, can derive from information as to the specific gravity of each species relative to *hydrogen:* in the case of native silver, for example, he is told that the specific gravity ranges from 115,123 to 117,369! And in any case what is

the experimental value of the last three or four figures? The specific gravity of each species relative to water is given as usual, so that the reference to hydrogen is only an additional torment for the learner. We doubt too the wisdom of explaining specific and atomic heats, and giving lists of their values. Isomorphism and pseudomorphism are hopelessly confused and interchanged on p. 20, while the illustrative formula is quite unintelligible. The adjusting apparatus of the ungraduated goniometer is, as usual in text-books, wrongly disposed for use. We have noticed several mistakes of fact and errors of printing; but the book is neat in style, and perhaps will not do much harm.

The Prospector's Handbook. By J. W. Anderson, M.A., F.R.G.S. 8vo, pp. 132. (London: Crosby Lockwood and Co., 1886.)

THE author, after traversing the mineral fields of New Zealand, New Caledonia, New Mexico, and Colorado, feels convinced that some simple guide or handbook for the use of prospectors as well as travellers is a desideratum, and the present volume is the outcome of this conviction. It contains a number of notes or paragraphs upon subjects incidental to metallic mining, which are distributed into chapters under the different heads of prospecting, rocks, blowpipe-testing, character of minerals, metals, and metallic ores, other useful minerals and ores, composition of various rocks, testing by the wet process, assay of ores, and surveying; to which are added an appendix of tables and a glossary of terms. As the whole text is contained in rather more than a hundred pages, not very closely printed, it will be easily understood that no one of the numerous subjects included in the author's programme is very thoroughly treated. The best part of the book is the introductory chapter on prospecting, which contains some useful generalisations on mineral deposits and the search for them, which, however, are more likely to be of use to the "tender-foot" than to the prospector properly so called. It would seem, however, that this is what the author has in contemplation, as, from some remarks on p. 9, he appears to consider prospectors and miners as two different classes of men, and evidently has no very favourable opinion of the latter. Our own experience points in the opposite direction and leads us to regard typical prospectors as representing the highest and most intelligent class of operative miners. Unfortunately it is difficult to keep them on regular mining works except during the winter time, when the mountain regions are inaccessible.

The remainder of the book is of very little value. The descriptions of minerals are short, without being clear, and in many cases far from accurate. Thus, the composition of galena is stated to be "80 per cent. of lead, the rest sulphur"; malachite is said to contain 70 per cent. of copper, and silicate of zinc about 67 per cent. of zinc. All of these statements are incorrect, and it is not easy to see why they have been made, as no more space would have been required to give the composition corresponding to the theoretical constitution.

The sections on assaying and analysis are not likely to be required by the prospector in the field, and are too vague to be of much use to sedentary students. A description of the methods adopted in sampling gold and silver-bearing vein-stuff in the Western States and Territories of America would have been of interest, but we find no notice of this or any analogous practice followed elsewhere.

The glossary at the end contains several curious definitions, many of which, however, are reproduced from previously published works. The description of the term "tribute" more properly applies to dues or royalty rents as understood in this country. It may be that the author's definition applies to some local foreign usage, but this is not stated. H. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Hereditary Stature

PERMIT me to correct one word in my memoir on "Hereditary Stature" in the last number of NATURE (p. 297, col. 1, line 6 from bottom), which should read "seven" on an average. I should be glad at the same time to amplify the passage in which it occurs, as follows:—

The chance that the stature of the son will at least rival the stature of the father, is not uniform; it varies with the height of the father. When he is of mediocre stature, that is, 5 feet 8¼ inches, out of every 100 sons born to a group of fathers of that height, 50 will be taller and 50 will be shorter than their fathers (the practically impossible case of absolute equality being neglected). Here then the chance of which we are speaking = 50 per cent. When the father is tall, the chance in question diminishes; when he is very tall, say 6 feet 5 inches, the chance is reduced to seven per thousand. The following table shows the probabilities in various cases. Columns A contain the height of the fathers, Columns B show how many per cent. of the sons will rival or surpass the height of their fathers:—

A	B	A	B	A	B
ft. in.	per cent	ft. in.	per cent.	ft. in.	per cent.
5 8¼ ...	50	6 0 ...	15	6 4 ...	1·4
5 9 ...	42	6 1 ...	9	6 5 ...	0·7
5 10 ...	31	6 2 ...	5	6 6 ...	0·3
5 11 ...	22	6 3 ...	3		

FRANCIS GALTON

Deposits of the Nile Delta

TWO communications from Sir William Dawson, published in NATURE of January 7 and 28 (pp. 221, 298), appear to call for a short notice from me. The report on the above subject which I read before the Royal Society on November 19, 1885, and of which an abstract appeared in NATURE of December 10, ought not to be referred to as "the report of the Delta Committee of the Royal Society." The origin of this report was as follows:—As there was no other geological laboratory available for the examination of the samples of delta-deposits sent home by Col. Maitland than the one connected with the Normal School of Science and Royal School of Mines, the other members of the Delta Committee requested me to undertake the microscopical and chemical investigation of the specimens. In preparing my report on them I was struck by the remarkable and unexpected characters which they presented, and I ventured to suggest a mode of accounting for them. When my report was submitted to the Committee I was requested to lay it before the Society; and, it would seem quite superfluous to add, neither the Committee nor the Society thereby accepted any responsibility for the views which I expressed in the report.

As Sir William Dawson lies under a manifest disadvantage in attempting to criticise a report which he has not seen, it will not be necessary to enter at length upon the subject of his communications. If I understand the first of these aright, he takes the opportunity in it of withdrawing his untenable assertion that "at a depth of 30 or 40 feet the alluvial mud rests on desert sand" in favour of the *totally different* statement that "the modern Nile mud" lies on "a Pleistocene or Isthmian deposit." In the absence of any palæontological evidence I can offer no opinion as to the truth of this latter view; but it is certain that the deposits above and below the limit mentioned are of precisely similar mineral characters. With respect to the second communication, I need only add that when its author has the opportunity of reading the report in question, he will find that the very obvious considerations to which he refers have been by no means lost sight of. JOHN W. JUDD

Stone Implements and Changes of Level in the Nile Basin

I INCLOSE a letter from my brother at Wady Halfa. The scrapers sent home are all made out of flat oval pebbles of

jasper, one side of which is left untouched, while the other is all chipped away except a small central area; most of them are unfinished. The few implements found among the quartz chips are very rough, and may be classed as lance-heads. The smaller pebbles of agate and carnelian seem to have been broken up in great numbers to obtain, out of the interior flakes, small articles about the length of the thumb-nail, of two types, pointed and rounded.

There is one doubly-pointed arrow head of jaspar carefully finished like Fig. 299 in Evans's "Stone Implements." Also several rough implements of larger size of impure basalt. Many of the hammer-stones are very characteristic, and have been much used. Others show the effect of attrition by sand, &c., as in those from the Irish sand-hills. F. ARCHER

Crosby, Liverpool, January 30

Wady Halfa, January 2, 1886

SIR,—When serving in the Soudan last winter, in the occasional walks I was able to take in the Desert I kept a look out for stone implements, but failed to find any until I reached Abri, where I picked up on the beach a well-worked flake, but much worn, of Egyptian jaspar.

Shortly after my arrival here I found several scrapers in the plain lying between the river and the hills, and more extended search led me to further discoveries. The hills at Wady Halfa, which are of sandstone capped with trap (?), are distant about a mile and a half from the present banks of the river, but at a bend of the Nile about eight miles below our camp the valley narrows, and the cliffs rise almost perpendicularly from the water's edge. To the south it widens to the extent of some six or eight miles between the hills on either bank. The whole of the plain between the sandstone ridges is covered with a deposit of Nile mud of unknown depth, but on the right bank this is to a great extent concealed by the sand and pebbles brought down in past ages by the river. The ground is uneven, here and there rising to mounds of hardened mud. There is, however, a gradual though slight rise towards the hills. Soon after my arrival I picked up a number of flakes of quartz, and found that they were most numerous in a belt of dried mud about half a mile distant from the river and a quarter of a mile in width, and tracing this northward I found a mound, some acres in extent, formed of mud and completely covered with sand and tons of chips of quartz, and also of agate, onyx, carnelian, and other hard stones. It was evidently the site of an ancient manufactory, and on this spot, in the many visits I have since paid to it, I have got numerous more or less well-fashioned specimens. Stone hammers may be picked up by the dozen, and these are made of many different minerals. The most interesting are those formed of silicified wood, of which large blocks, curiously polished by the action of the water and sand, are still lying on the river's bank. Tracing the belt further, I have found, both north and south of the camp for many miles, chips and hammers more or less abundant, and little water-worn. I have reason to think that the same is the case on the left bank.

Rambles in the desert, and search among the debris brought down by the Nile in former times were rewarded by the discovery of many roughly-worked flakes, evidently of much earlier date, being very much water-worn. These were widely scattered over the desert, being nowhere abundant. The highest point at which I found them was on the summit of a gravel-covered mound about 50 feet above the present level of the river.

A proof of the Nile having in former times flowed at a much higher level than it does at present, is found in the fact that valves of the peculiar Nile bivalve, *Ætheria*, may still be seen *attached* to the rock close to the foot of the hills, and at an elevation of some 30 feet above the present bank. As this shell must necessarily have lived always under water, the rocks when they are found must formerly have been part of the river-bed. If then as now the difference in height between high and low Nile amounted to 40 feet, it is evident that when the shells were living the stream flowed 60 to 70 feet higher than it now does. Whether the stream has receded or the land been elevated I am unable to decide.

It is stated in Murray's Handbook—I know not on what authority—that there is an inscription at Sannek, 35 miles south of Wady Halfa, which records that in the reign of Amenanhat III. of the twelfth dynasty, the Nile at that place rose to a point 27 feet 3 inches higher than it does at the present time. If this is the case and if the same were true as regards the river at this place, the implements and chips found in the belt previously mentioned are of a date subsequent to the reign of that king. I have found some hammers and flakes in the plain not far from the Nile, and very little above its present level.

If any traveller is desirous of obtaining specimens from this neighbourhood he will find a landmark in the British Military Cemetery, from which point the strip of desert in which the remains are most abundant may be traced north or south. The mound of chips is about a mile to the north of the graveyard overlooking an ancient water-course. S. ARCHER

P.S.—Since writing the above I have found another small mound with quartz flakes only between the Nile and the railway.

Parallel Roads in Norway

PARALLEL roads in Norway, such as those described by Mr. Hansen in your last number (p. 268), have already attracted the attention of several British geologists. Robert Chambers, a careful observer, saw and described them as long ago as 1849. His description, however (*Edinburgh Philosophical Journal*, vol. xlviii. p. 71), seems to be unknown abroad, and is not generally accessible anywhere. With your leave, therefore, I quote it entire.

"The valley of the Laugen, for several miles down, contains great masses of pure sand in the form of terraces and isolated mounts. On one of the latter Dovre Church is situated. . . . In this portion of the valley there is a terrace unlike the rest, in as far as it is a narrow ledge of detrital matter, running continuously along the hill-side for fully fourteen miles, however much more, while the terraces resting on the skirts of the hills lower down are great projecting masses, seldom extending far on one level. This remarkable terrace is most conspicuous on the south-west side of the valley. It begins on that side at Oue, between the Hougen and Tofte post-stations. It is there seen truncating the prominent ancient delta of a side stream, called, in Prof. Munch's map, the Jondals Elv, several hundred feet above the bottom of the valley. As we ascend the valley, it becomes nearer to our eye, but this is only because we rise to it, for, when examined with a correct instrument from its own elevation on the opposite side, it is proved to be for a great way truly horizontal. On the north-east side of the valley the corresponding mark is a line composed of slight projecting banks of water-laid sand. Though not continuous, this line is sufficient to have determined that of a long mountain-path connecting a series of farms. Beyond Lie post-station the road to Molde passes along it, and it here affords positions for a close series of hamlets, which make a conspicuous appearance in the map above cited. I believe it is nearly, if not exactly, of the same elevation with the little *hof*, called Dombaas, of which the height is given by Prof. Naumann as 2162 (English) feet. In its relation to the lakes in the summit between the two valleys (*i.e.* of Laugen and Rauma) it precisely resembles the lowest of the Inverness-shire *parallel roads*, as exemplified in Glen Spean, where advancing to the basin of Loch Laggan, between the Spean and Spey valleys. The terrace in every other respect bears a strong resemblance to the Inverness-shire *roads*, while in some important respects, as already noted, it differs from other terraces. I should much desire to see it obtain the attention of local observers, by whom its internal constitution and other features could be more particularly ascertained."

I offer this extract the more readily that the observations of the paper in which the passage occurs ("On Changes in the Relative Level of Sea and Land in Scandinavia") have scarcely received the attention, among Norwegian geologists, to which their care entitles them. Chambers further refers to the same terrace, in a descriptive and popular way, in his "Tracings in the North of Europe," a little volume reprinted (for distribution, fifty copies only) from *Chambers's Journal* in 1850. You will perhaps allow me to add this short reference to the other.

"In addition to the many sandy terraces at different and indeterminate heights, I discovered one of a much more remarkable character, passing along both sides of the valley for fully twenty miles, always at one elevation, and specifically identical as a terrace with the celebrated *roads* of Glenroy in Invernessshire. It first became visible at a place called Oue (pronounced Ouya) on the west side of the valley, where it truncates the ancient delta of a side stream far up the mountain-side. It is seen thence passing along through the scraggy woods without any interruption, till, on our turning out of the valley, we lose sight of it among the high grounds near Lässö Lake.

On the east side of the valley, perhaps 150 feet above the level of the road at Lie Station, I could distinctly trace this terrace by its hummocks of water-laid sand, and the farmhouses perched on its favourable points. A long series of hamlets on the road to Molde is placed upon it. As an object in physical geography, in its form, its uniform level on both sides of the vale, and its relation to the lakes at the summit-level, this terrace precisely resembles the lowest of the Glenroy terraces as it approaches Loch Laggan. It must, however, be more than twice the level above the sea" (p. 105). Chambers, of course, viewed it as an ancient sea-margin.

The same long terrace was also seen by my colleague, Mr. J. R. Dakyns, in 1872, and described (without reference to Chambers) in the *Geological Magazine*, 1877, p. 74. "If the terrace is on a level," he says, "with the watershed, and there is certainly no great difference between them, one is irresistibly led to think of the similar case of the parallel roads of Glenroy, and . . . of a gigantic Marjelen See dammed back by ice till it overflowed the summit of the pass at Molmen. It is significant that I could see no trace of terrace or water-mark on the Romsdal side of the pass. There is in the same district a second horizontal mark on the solid rock, several hundred feet higher than the 2000-feet one. This, too, seems to correspond with sand-terraces in the recesses of the high glens. . . . Here again it is striking that the water-mark should seem to correspond with the level of a watershed."

I myself saw Chambers's striking terrace in 1873. But I have nothing to add to the observations above quoted, and I make no claim whatever to have my name connected with them. But I may remark the fact that the little deltas or alluvial cones of the streams, where these cross the terraces, so conspicuously bear reference to the surface of the vanished sheet of water in which they were formed, as to remind one how greatly similar evidence was relied on by Darwin as demonstrating the *aqueous* origin of the roads of Glenroy. Mr. Hansen's discovery of parallel roads at the head of the Glommen and in Jemtland is very interesting, and I hope he will find time to study and *map* them in detail.

HUGH MILLER

51, Lauriston Place, Edinburgh, January 24

Meteorological Phenomena

ON January 4 last, while watching a very bright rainbow with a good secondary from Hoylake racecourse, I observed between the two bows a third, fainter than either, touching the primary at the base and extending upwards in such a way that probably, had it all been visible, it would have touched the secondary at the vertex. It was not all visible because of a break in the clouds. Its colours were in the same order as those of the primary, red outside. This third bow was only visible at one side; but a gentleman who observed it stated that he had seen it before, and symmetrical on both sides, though not extending to the vertex.

Another phenomenon I have observed here some time ago. A fall of hail lasting a few minutes occurred, the hailstones being exact cubes, of size about 7 mm. and of consistency like lumps of salt. JOHN C. WILLIS

University College, Liverpool, February 1

M. BARRÉ DE SAINT-VENANT

"WE have now to consider the earlier work of the greatest of living elasticians." Within a fortnight after these words were sent to the press, on January 6, M. de Saint-Venant died at Vendôme. The news of his death will have caused a deep feeling of regret among English mathematicians and physicists, to whom his researches are so well known that they have attained in their own field a classical value. We purpose in this notice to give some brief account of this foremost representative of latter-day French mathematical physicists.

Saint-Venant stood out for the younger mathematicians of the English school, as the link between the past and the present. Intimately related to the great period of French mathematical physics, he had continued to produce down to our own day, and we felt him to be as real a personality as Helmholtz or Thomson. A younger member of the school of Poisson, Navier, and Cauchy, he had yet lived to "edit" Clebsch. Deputy for Coriolis at the École des Ponts et Chaussées in 1837, Saint-Venant early received public recognition for his work from Poncelet in his lectures at the Sorbonne in 1840; within the next few years he corrected Cauchy's theory of torsion, and saw his correction accepted by the author of the "Exercices des mathématiques." More than forty years afterwards he "edits" what will long remain the standard treatise on elasticity—the annotated French translation of Clebsch. Thus his work is spread without a break across the middle fifty years of our century; he took up elasticity where Poisson had left it—a mathematical theory; he leaves it one of the most powerful branches of mathematics applied to physics and practical engineering; not a small amount of this transformation is due directly to his researches, or indirectly to his influence.

Turning to the personal character of the man, we find in him the essential characteristics of the scholar and the student, the truest modesty, the complete absence of self, the single-minded devotion to his study. Saint-Venant, whose researches on elasticity undoubtedly far surpass those of Navier and Clebsch, is yet content to appear as their *editor*. But what an editing it is! The original text is hidden, disappears, almost as completely as Peter the Lombard's "Sententia" in a mediæval commentary. It is Saint-Venant's notes, appendices, and corrections, which form the value of these works, which make the third edition of Navier's "Leçons" the standard treatise on the strength of materials, and the French translation of Clebsch the foremost work on mathematical elasticity. Nay, he even praises Clebsch for inventing a term in 1862, which he himself had first proposed in the privately distributed lithographed sheets of 1837! Ever ready with advice and assistance, perfectly free from jealousy, Saint-Venant was a typical scholar. We had occasion, scarcely six months ago, to apply to him for assistance with regard to some of his earlier work. Within a few days we received a packet containing twenty-three of his memoirs, all carefully corrected, and many annotated. He expressed a lively interest in the progress of the "History of the Mathematical Theories of Elasticity," lending the editor of that work several French lithographed courses which were otherwise inaccessible, and accompanying them by letters which amounted almost to a dissertation on the history of elasticity.

"Je desire, bien cher monsieur, que ces quelques renseignements et documents puissent servir à l'utile travail historique que vous avez entrepris, et dont j'apprendrai avec plaisir la publication ainsi que le nom de l'éditeur. J'en verrais même avec plaisir les épreuves."

Shortly before Christmas we received from Saint-Venant corrections for the first three sheets of Dr. Todhunter's ninth chapter, which is devoted to Saint-Venant's earlier work. On January 3 we sent him the remaining proofs of that chapter; a week afterwards we had to mourn the loss of one whose personal kindness had served to intensify the respect raised by his transcendent mathematical ability.

If we examine the leading characteristics of Saint-Venant's scientific work we find them marked by an essentially practical character. We find subtlety of analysis combined always with practical physical conceptions. The problems he attacks are those which are physically possible, or of which the solution is an immediate practical need. He smiles good-naturedly over Lamé's attempts to solve the terrible problem of an elastic solid in the form of a right-six-face, whose surface is subjected to any system of load. The solution would be a triumph of analysis, but its physical and practical value would in all probability be *nil*. He chooses instead a *real* beam, and he obtains a solution which, if it be but approximate, is at least an approximation to reality, and will serve all practical purposes. Saint-Venant never

troubled himself with impossible distributions of load over impossible surfaces, but took the problems of mechanics as they occurred practically, and solved them for practical purposes. This tendency on his part was no doubt greatly due to his training as an engineer. He was Ingénieur-en-chef des Ponts et Chaussées; he had been Professeur de Génie rural à l'Institut agronomique; he had built lock-gates and improved the gutters of Paris; he was an authority on agricultural drainage, and had investigated the best form of the ploughshare; he designed a bridge for the Creuse, and planned a method, afterwards adopted, for drying up the vast marshes of the Sologne. Yet with all this he was a great master of analysis, and knew how to make his analysis fruitful in practice.

It is not our purpose here to give a bibliographical account[1] of Saint-Venant's works; we wish only to sketch the general scope of his researches, and shall confine ourselves to indicating the more important advances he has made in his own peculiar subject—that of elasticity. The first important work by Saint-Venant is the "Cours lithographiée" of 1837. This consists of lithographed sheets given to the students of the École des Ponts. A few years previously Vicat had made his crushing attack upon the accepted mathematical—the Bernoulli-Eulerian—theory of beams. Here we find this attack justified and replied to by the introduction of the neglected slide (*glissement*) into the theory, and its application to a number of practical problems. Here, too, we see for the first time the true limit of elasticity expressed by a strain, and not a stress, maximum. This is a correction of the old theory which is of primary practical importance, although the old theory is still to be found in many English practical books, and even in such a theoretical authority as the German Clebsch.

A thorough appreciation of the true relation of theory to practice is evidenced by the following lines, which should be taken to heart by every technical teacher:—

"L'usage des mathématiques cessera de s'attirer des reproches si on le referme dans ses vrais limites. Le calcul pur est simplement un instrument logique tirant des conséquences rigoureuses de prémisses posées et souvent contestables. La mécanique y joint bien quelques principes physiques que l'expérience a mis hors de contestation, mais elle laisse aux expériences particulières le soin de déterminer quelles forces sont en jeu dans chaque cas, et il règne toujours à cet égard plus ou moins d'incertitude qui affecte nécessairement les résultats. Ces résultats ne doivent point être considérés comme les oracles, dictant infailliblement ce que l'on doit décider; ce sont de simples renseignements, comme les dépositions de témoins ou les rapports d'experts dans les affaires judiciaires, mais des renseignements extrêmement précieux et dont on ne doit jamais se priver, car il est extrêmement utile à la détermination que l'on a à prendre, de connaître la solution exacte d'un problème fort rapproché de celui qui est proposé, et de pouvoir se dire, par example, 'si les efforts étaient exactement tels ou tels, les dimensions à donner seraient telles ou telles.' De cette manière le champ de *l'appréciation instinctive* se trouvera réduit aux différences qui ne peuvent pas être le sujet du calcul théorique; et l'on voit que ces deux méthodes, loin de s'exclure, peuvent concourir ensemble, se suppléer et s'aider mutuellement, se contrôler même quelquefois,—enfin contracter sous les auspices du bon sens, une alliance féconde en résultats utiles sous le double rapport de la convenance et de l'économie."

These words represent exactly the spirit with which Saint-Venant entered upon the important investigations of later years. Of other earlier work of Saint-Venant, we may especially note the series of papers in the *Comptes rendus* for 1840-50. These contain the rectification of the theory of elastic rods by the introduction of the third moment in the case of inertial æolotropy in the section,[1] the complete equations for spiral springs, and the first rectification of the theory of torsion by the discovery of the distortion of the primitively plane section. These researches are all epoch-making in the theory of elasticity. To the next decade belong the classical memoirs on "Torsion" and "Flexure," the complete treatment of torsion on the basis of the distortion of the plane sections, and the complete treatment of flexure by the consideration of slide. The beautiful diagrams of the contour lines are known to all students of physics, if not from the original memoirs, at least from the "Treatise on Natural Philosophy" of Thomson and Tait. The very perfect plaster models prepared under the direction of Saint-Venant to illustrate flexure, torsion, and resilience, are less generally known,[2] but for teaching purposes they are of even greater value than the diagrams. In addition to these *opera maxima* we may mention the important researches on impact, belonging to the same period (Société Philomatique, 1853 and 1854). The decade received its final touch in the first volume of Saint-Venant's edition of Navier's "Leçons." This volume presents the first history of elasticity in the brief but luminous "Historique abrégé."

The last period of Saint-Venant's work contains the all-important memoirs on the distribution of elasticity in æolotropic bodies, on the various types of homogeneity, further researches on longitudinal impact, the tract on the undulatory theory of light, the second volume of Navier's "Leçons," the treatise on elasticity in Moigno's "Statique," and, amid a variety of *opuscula*, to crown the work of a life, the annotated edition of Clebsch's "Theorie der Elasticität." The original "Clebsch" contains 420 pages, the annotated translation with a much larger page has more than 900 pages. When will an English elastician arise, who will annotate Saint-Venant as Saint-Venant has annotated Clebsch?

One word more with regard to Saint-Venant's position as an elastician. In England the controversy over the number of elastic constants seems to have been decided in favour of multi-constancy. Saint-Venant was, and remained to his death, a supporter of the French, or rari-constant, hypothesis. The experiments, he argued, upon which the multi-constant elasticians based their theory were not made on truly elastic bodies, or were made upon bodies like wires and plates which are not isotropic. Into his treatment of such bodies he introduced, not the two constants of isotropy, but the constants of a cylindrical or planar distribution of homogeneity. Being written to last September on this point, he replied:—

"Vous voulez bien me demander si je conserve les mêmes opinions que j'ai exprimées et longuement developpées à l'appendix V. de mon édition de Navier, à savoir, la réduction des coefficients des formules d'élasticité à *un seul* (où $\lambda = \mu$ dans les formules de Lamé); ce qui conduit d'après le même principe que chaque action entre deux molecules est fonction de leur seule distance mutuelle, à réduire pour la contexture hétérotrope le plus générale, et à ne reconnaître que 15 coefficients distincts et non pas 21.

"Je reponds *oui* pour les vrais solides (supposés isotropes) comme sont les métaux ordinairement, ainsi que le marbre, le verre; mais *non* si l'on veut absolument par un motif quelconque que je ne conçois guère, appliquer les formules de l'élasticité au caoutchouc, aux gommes molles, aux gelées, et aux autres corps mous et élastiques, car ces corps-là ne sont que des mélanges de tissues cellulaires, de membranes élastiques, et de fluides visqueux que leurs cellules contiennent."

[1] A bibliography of his memoirs relating to elasticity and the strength of materials will be given in the "History of Elasticity." A complete bibliography to 1864 will be found in "Notice sur les travaux . . . de M. de Saint-Venant," Paris, 1864. This is brought up to 1885 with partial completeness in the copy presented to us by Saint-Venant himself.

[1] He shares the honour of this discovery with Bellavitis.

[2] We have a copy of the whole collection at University College.

Perhaps the constant-controversy is not quite so obviously settled as some English physicists seem to think. But, however the future may regard it, history will record that on January 6 of this year died one of the greatest mathematical physicists and undoubtedly the greatest elastician that Europe has seen since the age of Poisson and Cauchy. KARL PEARSON

ON SOME INTERESTING CASES OF MIGRATIONS OF MARINE FISHES, ON THE COAST OF VENEZUELA AT CARUPANO

CARÚPANO is a thriving seaport on the northern coast of Venezuela, midway between the peninsulas of Araya and Paria, in lat. 10° 14′ 15″ N., and long. 63° 18′ W. from Greenwich, and therefore in close vicinity to the channel which leads from the Atlantic into the Caribbean Sea between Tobago and Grenada on the one side, and Trinidad and the South American mainland on the other side. Through this channel enters the great western current of the Caribbean Sea, running at the rate of about one mile and a half an hour, though not with much regularity. The coast-line forms the western prolongation of the northern shore of Trinidad, trending almost due west. The water is rather shallow to a considerable distance from the land, the 100-fathom line due north of Carúpano being about 60 miles off the shore,[1] which gives for the sea-bottom a gradient of but 1·67 per 1000.[2]

Such are, in a few words, the general hydrographic conditions of that locality, famous in this country for the frequent occurrence of immense shoals of fish of different kinds, which, either alive or dead, are finally thrown by the surf on the beach. The inhabitants call the shoals *ribazones* when the fish arrive alive; in the other case they are called *turbios*, on account of the turbid appearance the sea presents in such circumstances.

Though the *ribazones* may occur at any time of the year, it appears that there is a greater probability of their advent during the rainy season, or from May to November. The weather must be fine, with a moderate breeze from the sea. The shoals are composed of a great many different species; most of the fish are, however, of small size. They are followed by large numbers of predatory denizens of the deep, sharks being generally prominent amongst them. In some cases the presence of whales has been recorded; it is undoubtedly the cachalot (*Catodon macrocephalus*), which occasionally visits the Caribbean Sea.[3] At the same time large flights of sea-gulls accompany the shoal, picking up a considerable number of fish, and, with their deafening shrieks and endless whirls, adding to the picturesque vividness of the scene. Owing to these manifold persecutions the frightened fish make towards the shallow water of the shore in such haste and with such impetuosity that the sea is almost boiling with foam for many miles. Most of the fish are still alive when they reach the beach, where the inhabitants, gathered in large crowds, are not slow in securing as many as they are able to carry away. By far the greatest number die on the shore, however, and their remains form a true *cordon littoral*, several feet in width and height, which soon fills the air with a most offensive smell.

The latest *ribazon* occurred on the morning of Oct. 10 last. The shoal seems to have come from the north-west, and was extraordinarily large. It contained such species as the "pargo" (*Lutjanus profundus*, Poey, the same as *Mesoprion aya*, Cuv. and Val.), which, as I am informed, had never been observed in any other *ribazon*. The Royal Mail-steamer *Severn*, going eastward at a speed of about eight miles an hour, was for two hours (from seven to nine in the morning) literally cutting through the shoal, and as she struck its main course at an angle of 45°, approximately, the breadth of the shoal must have been ten miles at least.[1] The shoal finally ran on shore to the east of Carúpano, and such was the quantity of stranded fish, especially between the places called Hernan Vazquez and Guayacan, that the local authorities deemed it necessary to summon a large number of workmen, in order to have trenches dug in which to bury the dead fish.

With respect to the causes of these migrations, I think they cannot differ from those which give rise to the well-known migrations of marine fish in other parts, the search for food being no doubt the most important. The waters of the great western Caribbean current are richer in food than the comparatively quiet part of the sea north of the current. The fish travel, therefore, in this direction, and attract of course a gradually increasing number of their enemies. On the coast of Carúpano the fisheries are insignificant, and thus the shoals are not disturbed in their migrations until they reach the shore. Farther to the west, in the waters of Margarita, the case is different, the large fishery establishments of this island having constantly boats and crews in readiness to intercept the shoals, as soon as their arrival is announced by the fire-and-smoke signals of the look-out men stationed on the different headlands and other places known to be favourably situated. With regard to Carúpano, it is certainly a great pity that the fisheries are so neglected that every year a large amount of what ought to be a rich harvest is lost, and left to turn into noxious and fever-breeding carrion.

The *turbios* are *ribazones* during the arrival of which submarine eruptions of deleterious gases, principally sulphuretted hydrogen, happen to break out, so that the fish are killed before they reach the shore, the water at the same time becoming turbid with the mud from the bottom, which is violently stirred up by the outbreak of the gas. The quantity of the latter must be very considerable indeed, as the foul smell on such occasions is noticed all over land and sea.

Gaseous eruptions of the same nature, as well as sulphurous springs, are not at all uncommon in the neighbourhood of Carúpano; the two *azufrales*, about twenty miles to the south of the town, being the most important.[2] The whole region, in fact, was at the end of the Tertiary period the theatre of a great geological catastrophe, when the Golfo Triste was formed by a sudden subsidence, which was also the origin of the so-called delta of the Orinoco,[3] the Gulf of Cariaco, and the many lagoons in the provinces of Cumaná and Maturin. At the same time extensive tracts of land were submerged to the north of the mountains which run through the whole length of the peninsulas of Araya

1 "Deep-Sea Soundings in the Gulf of Mexico and Caribbean Sea" (Chart No. 21 in *Report* of the U.S. Coast and Geodetic Survey, 1881, Washington, 1883).

2 I take the nautical mile, equal to one-sixtieth part of the length of a degree on the great circle of a sphere whose surface is equal to the surface of the earth = 1853·248m. or 6080·70 feet (J. E. Hilgard, "On the Length of the Nautical Mile," in the *Report* mentioned in the foregoing note, pp. 354-356).

3 There is in the Museo Nacional of Caracas a tooth of this species, from a specimen which was stranded some years ago on the shores of Margarita. I saw myself, in 1873, another whale, but only for about one minute, in the sea between the islands of Tortuga and Margarita. The animal swam with its mouth wide open and the head partially raised above the surface of the water. The upper jaw was small and narrow, so that it certainly was not a cachalot. Though I could not see the back, I supposed then it might be a Balænoptera, perhaps *B. rostrata*. However, I do not know whether this species comes so far to the south.

1 From information given to me by Señor Bastardo, a medical student at our University, who was a passenger on board the *Severn*.

2 Wall and Sawkins, "Report on the Geology of Trinidad," London, 1860, p. 198.

3 The Orinoco has no delta in the true geological sense of this word, as the land comprised between the outer branches of the intricate fluviatile plexus of its mouth has *not* been formed by the river. The southern branch is the old river channel; when the above-mentioned subsidence took place, the land on the left bank sank gradually towards the north, and part of the waters, following the new slope of this northern plane, cut into it the different channels with their connecting branches which, after a slow and tortuous course, empty into the sea between the old mouth of the river and the southern entrance of the Golfo Triste.

and Paria, and thus the Sea of Carúpano was formed. That the South American mainland extended before this catastrophe as far as Grenada, Tobago, and Trinidad, is sufficiently proved by the investigations of Mr. Bland on the land shell fauna of the West Indies, and is moreover corroborated by the comparative shallowness of the sea between the coast of Venezuela and the islands mentioned. Tobago is still within the 100-fathom line, and a rise of the sea-bottom of no more than 400 fathoms would be sufficient to re-establish the terrestrial connection with Grenada.[1]

It is self-evident that an immense quantity of organic matter must have been buried with the sunken land. This organic matter contributes to the formation of sulphuretted hydrogen, and is the stratum which feeds the submarine petroleum springs on the coast of Barcelona; whilst in those parts which afterwards were again lifted above the surface of the sea, it appears in the extensive deposits of asphalt known in Trinidad and Maturin, and performs an active part in the generation of the sulphurous vapours of the *azufrales*.

If we consider what a large quantity of fish-remains must gradually accumulate in the shallow waters on the coast of Carúpano, where they are slowly covered by successive layers of finely-sifted sediment, we are enabled to understand how other deposits of a similar character, for instance, that of Monte Bolca, have been formed in bygone ages; indeed, Carúpano will, in time, be another Monte Bolca to the palæontologist of the Coming Race.

Caracas University, October 22 A. ERNST

KILIMA-NJARO[2]

THE rapid progress of African exploration during the last quarter of a century is strikingly exemplified in the brief history of the monarch of African Mountains. Doubtfully alluded to as the "Ethiopian Mount Olympus" by Enciso in the sixteenth century, and absolutely unknown to science before its discovery by Rebmann in 1848, it has already since that year been several times visited, partly explored, and even ascended to heights of 10,000 and 14,000 feet by Baron von der Decken in 1861-62, by the Rev. Charles New in 1871, and by Mr. Joseph Thomson on his memorable journey "Through Masai Land" in 1883. And the work of these pioneers has now been all but completed by Mr. Johnston, who was early in 1884 specially commissioned by the Royal Society and the British Association to study the interesting fauna and flora of the Kilima-Njaro uplands. During the six months from May to October of that year, passed by him on their southern and eastern slopes, this experienced African traveller has succeeded under great difficulty in collecting abundant materials for illustrating the natural history and physical constitution of the "Mountain of the Snow Fiend," as its euphonious Ki-Swahili name is interpreted. These results are embodied in the work before us, which is alike admirable for its bright and graphic style, and the judicious arrangement of its varied contents. By the simple plan, consistently adhered to throughout, of treating the narrative portion separately, and confining the strictly scientific matter to the concluding chapters, all tastes are consulted, and the common mistake is avoided of sacrificing the interests of the student to those of the general reader.

The few months to which the expedition was limited were passed partly at the station of Kitimbiriu in the Moshi territory ruled over by King Mandara, partly in the more easterly district of Marangu. Both of these tracts are included in the Chaga country, which occupies all the southern slope, which however, as now appears, does not constitute a single kingdom under Mandara, but comprises a considerable number of petty Bantu States, mostly mutually hostile, and seldom combining except to resist the attacks of the common Masai enemy. Mandara, who had hitherto figured in the history of recent East African exploration as a doughty warrior scarcely second in importance to Mirambo himself, thus sinks to the position of a mere triton amongst the minnows, though still powerful enough to be troublesome, and enjoying a somewhat widespread reputation, if not for personal courage, at least for political sagacity.

As shown in the annexed cut (Fig. 1) the aspect of Kilima-Njaro seen from above Moshi is that of a single snow-capped dome towering to a height of nearly 19,000 feet above the bare or grassy upper slopes, and clothed lower down with a dense and varied tropical vegetation. But when viewed from Lake Jipé, a point lying nearer its base towards the south-east, it appears in its true character of a double-crested snowy mass, in this as in some other respects presenting a remarkable resemblance to the Armenian Ararat. Mr. Johnston, who made two ascents, first from Moshi to a height of 9000 feet, and again from Marangu to about the normal snow-line (16,315 feet, or within a little more than 2000 of the summit), calculated the altitudes of the two peaks, Kibô and Kimawenzi, at 18,800 and 16,250 feet respectively. This only slightly exceeds von der Decken's estimate, who assigns 18,700 feet to Kibô, so that the absolute altitude of the probable culminating point of the continent may be taken at somewhat under 19,000. On the lofty connecting ridge clumps of forest were found still straggling up to 10,000 feet. Many bright-coloured flowers also grew up to this altitude, "notably a vivid blue cynoglossum (houndstongue), mauve and blue irises, and pink, waxy-white, and yellow everlastings. Tufts of artemisia (southernwood) grew in sheltered places. There were many heaths, a small kind of geranium, huge proteas, and divers ferns and mosses" (p. 235). Even at 12,600 feet strange sessile thistles were met, nearly five feet in circumference, besides an extraordinary lobelia (*L. Deckeni*) three to four feet in height, and a very characteristic arborescent plant new to science, and since named *Senecio Johnstoni* (Fig. 2), "looking somewhat like a banana in the distance, but in reality consisting of a tall, black, smooth trunk, 20 to 30 feet in height, and surmounted by a huge crown of broad leaves interspersed or headed up with bunches of yellow blossom. The strange composite grew abundantly in the streamlet's bed, and its trunk was so superficially rooted that, in spite of its height and girth, I could pull it down with one hand" (p. 268).

Beyond 13,000 feet vegetation became stunted and patchy, ceasing altogether about the altitude of 15,000 feet. The last resident bird, a kind of stone-chat (*Finarochroa hypospodia*) was met in flocks, and showing a total absence of fear, up to 13,700 feet, beyond which no bird was seen except a rare high-soaring kite, or great-billed raven. Yet such large game as the elephant, buffalo, and antelope are pursued by the natives up to altitudes of 12,000 and 13,000 feet, and captured chiefly by pitfalls. In the Bura district, east of Kilima-Njaro, the *Alcelaphus cokei*, a species of hartebeest, or tall red antelope, was seen associated by a sort of unconscious symbiosis with tall red ant-hills, and deriving some protection from their almost ludicrous resemblance to these objects. "Being a deep red-brown colour, and standing one by one stock-still at the approach of the caravan, it was really most difficult and puzzling sometimes to know which was antelope and which was ant-hill; for the long grass hiding the animal's legs left merely a red-humped mass, which until it moved, might well be the mound of red earth constructed by the white termites. The unconscious mimicry was rendered the

[1] See the chart quoted in the first note.

[2] "The Kilima-Njaro Expedition, a Record of Scientific Exploration in Eastern Equatorial Africa." By H. H. Johnston, F.Z.S. (London: Kegan Paul, 1886.)

more ludicrously exact sometimes by the sharply-pointed, flag-like leaves of a kind of squill—a liliaceous plant—which frequently crowned the summit of the ant-hill or grew at its base, thus suggesting the horns of an antelope either with the head erect or browsing low down. The assimilation cannot have been fancied on my part, for it deceived even the sharp eyes of my men; and again and again a hartebeest would start into motion at twenty yards' distance and gallop off, while I was patiently stalking an ant-hill, and crawling on my stomach through thorns and aloes, only to find the supposed antelope an irregular mass of red clay" (p. 66).

Amongst the valuable animal specimens secured by our naturalist was one of the new and beautiful species of Colobus (*C. guereza*, Rüpp., var. *caudatus*, var. nov., Fig. 4) first seen and described by Mr. Thomson, which

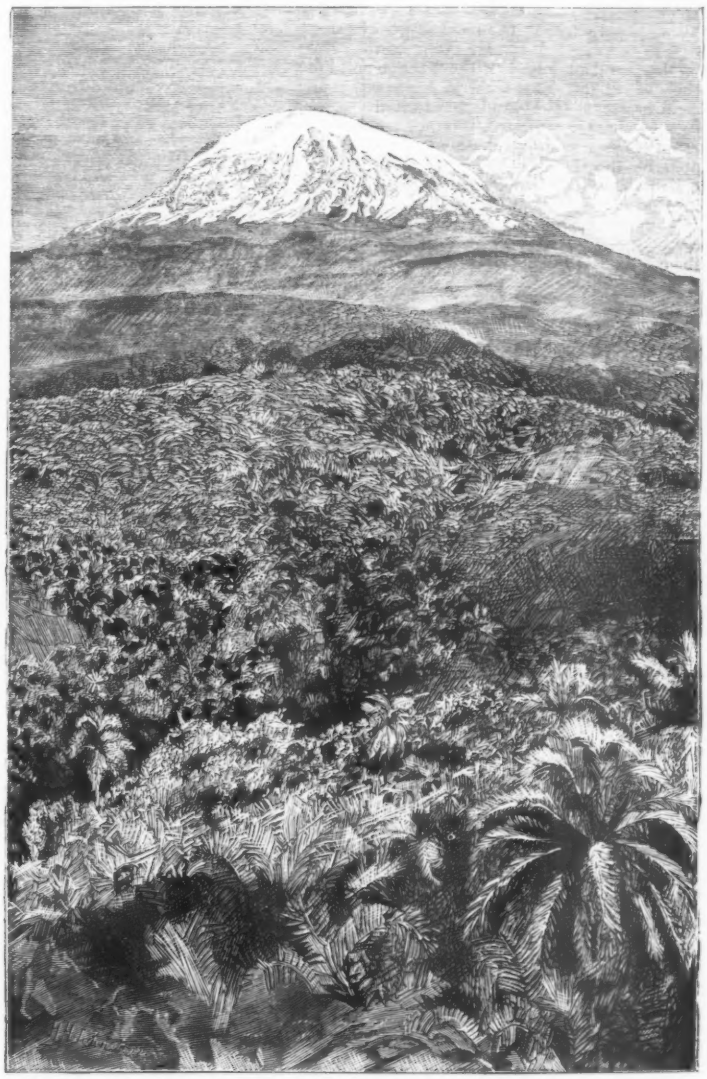

FIG. 1.—Kilima-Njaro seen from above Moshi ("Palms and Snow").

frequents the base of Kilima-Njaro, and is apparently restricted to that region. Mr. Oldfield Thomas, who contributes an important paper on the mammals obtained during the expedition, tells us that it is "characterised by having the white brush of the tail very much larger and finer than is the case in the true Abyssinian *C. guereza*. . . . The hairs of the white body-mantle, entirely cover he black at the base of the tail, the white of the latter and of the mantle being quite continuous" (p. 388).

Besides this paper by Mr. Thomas the work is enriched with several others by specialists, such as Prof. Bonney, who deals with a collection of rocks (mainly igneous) from the higher regions of Kilima-Njaro; Prof. Oliver and Mr. J. G. Baker, to whom botanists will be grateful for a careful enumeration of all the plants collected during

the expedition; Mr. F. D. Godman who classifies sixty-one specimens of Lepidoptera, including at least three new species; Charles O. Waterhouse, by whom examples of fifty-six Coleoptera are similarly treated; Captain G. E. Shelley, who jointly with the author gives a descriptive catalogue of fifty species of birds, of which six are new to science, collected or observed in the district; Mr. E. J. Miers, who describes a new variety of river-crab of the genus Thelphusa doubtfully assigned to the species *T. depressa*, Krauss.

But of all the scientific papers by far the most important are the two chapters contributed by Mr. Johnston himself on the anthropology and philolgoy of the Kilima-Njaro district, or rather of all the East Central African region lying between the great lakes and the Indian Ocean. Measured by a pecuniary standard, it is not too much to say that these two monographs alone are fully worth the 1000*l.* granted by the British Association and Royal Society for the purposes of the expedition. Besides a graphic account of the Bantu and Masai peoples, whose respective domains are conterminous, or overlap each other in this part of the continent, we have here a general disquisition on their mutual ethnical and linguistic

FIG. 2.—*Senecio Johnstoni*.

relations, which fills up at least one great gap in the field of African anthropology. The mystery hitherto surrounding the Masai race is at last largely dissipated, and we are now enabled with some confidence to assign them their true place in the African family. A careful comparative study of their language and physical type clearly shows that their affinities are to be sought amongst the Negro or Negroid peoples of the White Nile, and more particularly the warlike Bari nation of the Gondokoro district. From this basin they appear to have gradually spread in comparatively recent times south-eastwards between the Victoria Nyanza and the coast, encroaching to the east on the Hamitic Gallas, to the south on the Wa-taita, the Wa-chaga, and other outlying branches of the Bantu family. The annexed graphic illustration of a Masai warrior (Fig. 3) betrays some unmistakable Negro features, especially in the short nose, broad nostrils, and thick lips standing wide apart. On the other hand, the close relationship of the Masai and Bari languages is here clearly established, one of the most striking features common to both being true grammatical gender, as indeed had already been pointed out by Lepsius in his Nubian Grammar. Masai must consequently now be separated from the Nuba group, as the Nuba has already been separated from the Fulah of Western Sudan; and thus there is at last an end of Friedrich Müller's "Nuba-Fulah family," which has hitherto figured so largely in treatises on African philology. Its place is taken in East Central Africa by the Bari-Masai group, which Mr. Johnston now proposes to constitute, and which includes, as intervening members, Latuka certainly, Lango, Sûk, and Samburu more doubtfully.

FIG. 3.—A Masai Warrior.

It will be seen that the rich linguistic data here brought together cannot be neglected by the future student of African philology. The patience and ingenuity expended in the collection of this material is aptly illustrated in the account given of a hunt after a single grammatical element of the Ki-Chaga language current throughout the southern districts of Kilima-Njaro. The object is to determine the exact form of the eighth pronominal prefix

(a plural one), of which fifteen altogether are represented in this member of the Bantu family. But "unfortunately I cannot ask any of my friends, 'What is your eighth prefix?' I should never be understood if I explained for a hundred years. I have to get at it in some other way. 'What is this?' I ask, holding up a knife. 'Ki-osho,' they reply. 'Just so,' I replied; 'ki' is the seventh prefix, and the plural must give the form of the eighth. 'How do you say many knives,' I continue; 'ki-osho is *one;* what is many?' 'Shingi' (many), they reply. 'No, but many knives?' 'Shingi' is again repeated. Then I ask, 'See, this is one knife—*ki-osho kimo* (holding up one finger). What is for *two* knives?' (holding up two fingers). 'Two fingers,' they reply, looking up very much puzzled. Then in despair I send for another knife, and placing it beside the original one, again ply them with a question. This only elicits the word for 'another'; but at length after many disappointments they are induced to say *shi-osho shivi* (*two knives*), which gives me *shi-osho* as the plural of *ki-osho*, and consequently *shi* is the form of the eighth prefix, and so on" (p. 162). Of course all travellers amongst the lower races are familiar with difficulties of this sort. But it is not every traveller who during the off hours of a six months' expedition contrives to collect sufficient linguistic materials to reconstitute the philology of a continent.

Mr. Johnston, who is also an accomplished artist, has added much to the value of his work by the numerous illustrations with which he has enriched this handsome volume. His skill especially in portraying animal and vegetable forms is sufficiently attested by the specimens here adduced. He also supplies a copious index, as well as carefully prepared route and linguistic charts, besides a large map brought well up to date of Eastern Equatorial Africa between the parallels of 1° N. and 6° S. It remains to be stated that in this notice the somewhat unfamiliar orthographic system of Lepsius, adopted by the author, has been replaced by the usual and sufficiently accurate method adhered to by Stanley, Thomson, and most other English travellers in Central Africa. To the writer it seems that the plan of combining the English consonantal with the Italian vocalic system adapts itself fairly well to the transliteration of most African (Negro) and especially of the Bantu languages. A. H. KEANE

FIG. 4.—*Colobus guereza*, var. *caudatus*.

NOTES

LORD ROSEBERY has endowed a new lectureship in the University of Edinburgh. The course, which will extend over five years, will consist of thirty lectures on the Philosophy of Natural History. The lectureship has been offered to, and accepted by, Mr. G. J. Romanes, M.A., LL.D., F.R.S. This is the second lectureship which has recently been founded in connection with the Chair of Natural History. The other one is on Comparative Embryology, and is occupied by Mr. G. Brook, F.L.S.

AN important discovery has been made by Dr. O. Tumlirz, of Prague. Hitherto no substance amongst those which exhibit diamagnetic properties has been observed to possess any per-

manent diamagnetic polarity analogous to the permanent paramagnetic polarity of hard steel. The property of retention of diamagnetisation is, however, found to be possessed by rock crystal. Both those specimens which show right-handed and left-handed optical properties are alike in this respect, and the axis of diamagnetisation appears to be independent of the crystallographic axis, and dependent only on the axis of initial magnetisation. Dr. Tumlirz, whose investigation is published in *Wiedemann's Annalen*, appears to think that these facts negative Becquerel's theory of diamagnetism.

WE regret to announce the death of Dr. Oskar Schmidt, the eminent Professor of Zoology at Strasburg University; he died on the 17th ult. Also of Dr. Nikolaus Friedrich von Tschudi, the well-known author of the "Thierleben der Alpenwelt." He died at Melonenhof, near St. Gallen, aged sixty-five years.

M. FAYE has been appointed President of the Bureau des Longitudes for 1886.

DR. W. H. STONE will deliver the Lumleian Lectures this year on April 8, 13, and 15, the subject being "The Electrical Conditions of the Human Body."

TWO young persons, natives of the central part of Paraguay, are being exhibited at the Westminster Aquarium possessing an abnormal development of hair on the body, a condition to which the term hypertrichosis is applied. One of these is a girl of about eighteen years of age; the other, her brother, aged six years. In the former the whole of the back is covered with hair about one centimetre in length, which extends in the region of the waist to the anterior surface of the body. In addition to this continuous tract of hair there are numerous small patches of varying size distributed irregularly over the face, trunk, and extremities. In the boy the hair tract on the back begins immediately below the level of the lower angles of the scapulæ and extends downwards on the body and extremities almost to the bend of the knees. There are likewise on the body several patches covered with hair, the largest of which is about the size of the palm of the hand, and situated on the front of the thigh; the other patches vary in size from about one to two centimetres in diameter. Contrary to what might have been expected, there is no development of hair in the mesial line of the body in front, or on the cheeks, chin, or upper lip, as is sometimes seen in such cases. In both cases the skin is deeply pigmented, of a dark brown hue wherever the abnormal hair is developed, and on the back of the girl and outer side of the thigh of the boy there is a large and partially filled cist present immediately below the skin. The cist on the boy's thigh seems to be entirely unconnected with the bursa over the trochanter of the femur with which it might be imagined it had some connection. In the family history there is nothing to account for the occurrence of the abnormal condition presented by these two members of the family. The parents are in all respects reported to be normal, as are the other members of their family, which consists of four children in all. In no other respect do the two abnormal members of the family present any peculiarity, such, for example, as in the growth of the teeth, which is not unfrequently found to accompany extra development of hair. Cases of this kind occasionally occur in different parts of the world. The hairy family from Burmah has been the subject of several notices some years ago, and more recently a child from the same country was exhibited at the Aquarium. Several other cases have been recorded, however, occurring in Russia and different parts of America, and other places. The hair sometimes occurs universally spread over the body, when the term *hypertrichosis universalis* is applied to it, or in patches more or less extensive, *hypertrichosis partialis*, as in the present instances.

ONE of the most appreciated organs of French anthropology, the *Revue d'Anthropologie* of Paris, founded in 1872 by Paul Broca, and continued since the death of that distinguished *savant* by Dr. Paul Topinard, inaugurates the third series this year with the co-operation of the most distinguished representatives of the various branches of anthropological science. Amongst these we notice the names of Dr. Gevarret, Director of the École d'Anthropologie; Dr. Mathias Duval, Director of the Laboratoire d'Anthropologie de l'École des Hautes Études; the Marquis de Nadaillac, whose works on prehistoric archæology have been translated into several languages; Gen. Faidherbe, Great Chancellor of the Légion d'Honneur, and well-known for his philological works; Prof. de Quatrefages; Dr. Hamy and Louis Rousselet, who highly represent ethnography; Baron Larrey; Jules Rochard, of the Medical Service of the French Navy; D'Arbois de Jubainville, of the Institute; and several others. The editorship of the *Revue* will be retained by Dr. Paul Topinard, the General Secretary of the Anthropological Society of Paris, and author of the "Éléments d'Anthropologie," a work to which we recently called the attention of our readers, and for which we are glad to learn the author has been awarded one of the annual prizes of the Académie des Sciences.

THE first Report upon the Fauna of Liverpool Bay and the Neighbouring Seas, written by the members of the Liverpool Marine Biology Committee, and edited by Prof. W. A. Herdman, D.Sc., will be published during the present month, in the form of an octavo volume of about 300 pages, illustrated by six plates and a map.

AN exploring expedition was to start from Tiflis on the 2nd inst., with the object of thoroughly investigating the natural history of Khorassan. It will be under the direction of Dr. Radde, who will take charge of the botanical department and of the zoology of the higher animals. Dr. Walter, who was lately assistant to Prof. Haeckel at Jena, will have charge of the lower animals. M. Kontjin will be the geologist, and two general assistants will complete the scientific portion of the expedition. It is hoped that their work will be finished by the end of August. A number of specialists will be charged with the task of examining and describing the collections with a view to publication; and it has been already arranged that Dr. Boettger, of Frankfort, will deal with the mollusca, M. Strauch, of St. Petersburg, with the reptiles and amphibia, and Dr. Radde with the birds. It is understood that the Emperor has expressed a strong personal interest in the expedition.

THE Parisian authorities systematically liquefy the snow with salt, except on macadamised streets (where the process causes disaggregation of the stones). This practice has obtained since 1881. Rock-salt is used, costing in Paris about 31 francs a ton. Large quantities are stored in the beginning of winter at different places, and when a snowfall occurs a number of workmen repair to these, and each fills a barrow, and takes it to sprinkle on that part of the streets assigned to him. The salt produces its full effect only when the passage of vehicles has mixed it sufficiently with the snow. In two or three hours liquefaction is so far advanced as to allow of the streets being swept. The salt is little used on pavements. Paris spent about 220,000 francs on the fall of snow of December 8 to 10 last; the thickness of the layer varied from 2½ to 4 inches. The quantity of salt used was about 125 grammes on an average per square metre; the cost of it was only about an eighth of the total expense (sweeping cost 3 to 4 centimes per square metre). The employment of salt in the way indicated is found to effect a considerable economy on previous methods.

SOME experiments on a large butcher's dog, with reference to the effects of sundry beverages on digestion, have been recently

described by Signor Ogata (*Archiv für Hygiene*). The observations were made by means of a stomachal fistula (quite healed); the dog was fed on horse-flesh and fibrin from ox blood. The following conclusions (which may not be strictly applicable to man, accustomed to the drinks named) were reached:—(1) Water, water containing carbonic acid, tea and coffee in moderate amount, do not disturb digestion. (2) Beer, wine, and brandy retard digestion considerably at first, till absorbed; and in the case of beer, the extractive matters act thus as well as the alcohol. Thus beer retards digestion more than wine containing the same quantity of alcohol. (3) Sugar (cane and grape) retards digestion considerably. (4) Common salt accelerates it distinctly.

WE have received the report of the administration of the Museum of Science and Art at Dresden for the years 1882 and 1883, which has only just been issued. It contains nothing calling for especial note. The various scientific collections in the anthropological, zoological, prehistoric, and geological departments were largely increased during the two years by purchase, and specially by donations from private individuals, mainly travellers, or Germans residing abroad.

ON the afternoon of the 29th ult. a strong shock of earthquake was felt at Velez Malaga, which suffered so severely in the earthquakes of December 1884. The town is reported to have suffered little damage, although no precise details have yet been received.

ON January 29 earthquakes were again noticed at M'sila, Bordj ben Arendj, and Setif, Algeria, the site of previous commotions, but no accidents are reported, although the shocks are said to have been strong.

DR. F. J. HICKS writes from Madeira, on January 28, that in the previous week a sharp little shock of earthquake occurred on the island.

A TELEGRAM from Mexico states that the Colima volcano continues in active eruption.

THE last, or December, number of the *Journal* of the Royal Microscopical Society has a new feature, in the form of portraits of a number of past presidents of the Society; Sir Richard Owen, the first president of the Microscopic (1840-41), and Mr. James Glaisher, the first president of the Royal Microscopical Society (1865-66, 1867-68), have full-page illustrations; the two other plates contain eight vignettes each; on one (1842-57) we have, among others, Dr. Fane, Mr. Busk, and the lately deceased Dr. Carpenter, and on the other Mr. J. B. Reade, Mr. Quekett, and Mr. Sorby. Many, if not indeed all, of the photographs are excellent likenesses. We understand that it is the intention of the Society to publish other similar photographs from time to time.

THE so-called wines sent to the Parisian market of late years have been to a large extent, it is well known, vile concoctions, not deserving the name of wine, and a movement is now on foot for replacing such false wine by true cider. The year 1885 has been exceptionally favourable for such an experiment; the crop of apples was so abundant in Normandy and Brittany that growers were obliged to dispose of their products at low prices. Enormous quantities have been sent to Paris to be transformed into cider. It is to be hoped that this new development may check the great falsification of wine.

ON January 21 the exhibition of ethnological and natural history objects collected by Dr. Otto Finch, in his travels undertaken at the request of the New Guinea Society, was opened at the Berlin Ethnographical Museum. Dr. Finch himself gave the necessary explanations to the assembly. The objects were all collected in parts never before visited by Europeans. The collection contains numerous face-casts of the various New Guinea tribes and those of the adjacent island, as well as a large number of water-colour drawings of scenes in the new German colonies.

"H. I. M." writes to the *Times* under date Bratton Fleming, Barnstaple, January 28:—"As I was driving near Barnstaple yesterday evening with a friend, we noticed a most remarkable meteor. While we were ascending a hillside, we suddenly became aware of a brilliant light to our side and rather behind us, from over the hill-top. I thought for the moment that it was a flash of lightning, but on looking up we caught a glimpse of the most beautiful meteor I had ever seen. It seemed to be quite close, and described a path like that taken by a stone in falling when flung horizontally from a tower. It appeared (at its distance) to have a diameter of about 6 inches, and was accompanied by a tail of a smoky consistency, rather of the shape of an elongated open fan with the ends rounded, which followed it, altering its position from a horizontal to a vertical one as the body fell. This tail was, I should say, one and a half times as long as the meteor's diameter, and was of a much paler hue and less dense consistency than the meteor, which was of a most glorious yet rather pale emerald green, with a yellow flame, as it seemed, playing all over it; the tail was of the same tint, only in a less intense degree. It may be of interest to any who may have seen it, that the time we saw it was 27 minutes past 7 o'clock."

ELABORATE preparations are being made at the fishery of the National Fish-Culture Association at Delaford Park for receiving the fry which are now rapidly becoming incubated at the hatchery in South Kensington, special habitats being constructed for them. The whitefish ova that arrived from America last week commenced to hatch out immediately they were placed in the apparatus; indeed, many came to life during the voyage. Unlike other fry, they never rest, but move rapidly hither and thither, their powers of locomotion being marvellous considering their present alevin stage. Further consignments of eggs are on their way from the American Government, who are doing their utmost to aid fish-culture in this country. The fish reared at the Delaford Fishery last year will shortly be ready for distribution. The stock is extensive and valuable, including *S. sebago*, *S. fontinalis*, *S. ferox*, *S. fario*, *S. trutta*, and *S. iridens*.

A CLOSER investigation of the fish-fauna of Lake Balkhash permits M. Nikolsky to arrive at the following interesting conclusions (*Memoirs* of St. Petersburg Soc. of Natur., xvi. 1). The fauna numbers fourteen species, partly described by the late Prof. Kessler (*Perca schrenckii*, *Phoxinus lævis*, var. *balchaschana*, *P. poljakowi*, *Barbus platyrostris*, *Schizothorax argentatus* and *orientalis*, *Diptychus dybowskii*, *Diplophysa strauchii*, *labiata*, and *kungessana*), and three more *Schizothorax*, of which one new one has been described by M. Nikolsky as *S. kolpakowskii*. Of these fourteen species, only one is not new, and none of them has been found either in the Aral-Caspian basin or in the system of the Obi; on the contrary, the fish-fauna of Lake Balkhash is closely akin to that of the lakes of high Central Asia. In both, the Cyprinidæ and Cobitidæ are predominating; four genera of the former are found exclusively in Lake Balkhash and the Central Asian lakes, as also the species of *Diplophysa*. More than that, the *Schizothorax tarimi*, the *S. aksaensis*, and the *Diplophysa strauchii*, which were found by M. Nikolsky in the Ili River, are common to both the Balkhash and the Lob-nor. Only three species distinguish the Balkhash fauna from that of the Central Asian lakes, and make it approach that of the Obi: the *Perca schrenckii*, which, however, differs more from the European and Siberian species than this last differs from the American *P. stizostedion* (which, in fact,

might be considered as a mere variety), and the *Phoxinus poljakowi*, which is nearly akin to the *Ph. lævis* of the Obi and North-East Europe. From these facts M. Nikolsky concludes that if a direct communication between Lake Balkash and Lake Aral has ever existed—that is, if a marine basin ever covered once the three depressions of the Alatau, the Aral-Caspian, and Siberian—the former was separated from the two latter at a much earlier period than the time when, at least, a fluviatile connection between the Aral-Caspian and the Siberian Ocean had ceased to exist. The separation must have taken place earlier than the separation of the two continents of Asia and America. If a connection existed between the Balkhash and the Irtish during the Post-Tertiary period, it could be only by means of shallow streams where the *Phoxini* could live. On the contrary, the Balkhash and the Lob-nor remained connected after the above separation took place. The connection was carried on through Kunges, the Yuldus, and Tarim. The limits of this basin can be easily determined.

MESSRS. SWAN SONNENSCHEIN AND CO. will publish in a few days a "Tourist's Guide to the Flora of the Alps," translated from the German of Prof. Dalla-Torre, and issued under the auspices of the German and Austrian Alpine Club of Vienna. The volume will appear in the form of a handy pocket-book.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius* ♂) from South Africa, a Malbrouck Monkey (*Cercopithecus cynosurus* ♀) from West Africa, presented by Lieut.-Gen. G. W. A. Higginson, C.B.; a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mrs. J. J. Buchanan; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. H. M. Sharratt; a Common Badger (*Meles taxus* ♂), British, presented by the Hon. Walter de Rothschild; four Moorhens (*Gallinula chloropus*), British, presented by Mr. T. E. Gunn; three Gold Pheasants (*Thaumalea picta* ♂ ♂ ♂) from China, presented by Mr. A. Heywood, F.Z.S.; a Hygian Snake (*Elaps hygiæ*), a Hoary Snake (*Coronella cana*), a Crossed Snake (*Psammophis crucifer*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Great Cyclodus (*Cyclodus gigas*), two Stump-tailed Lizards (*Trachydosaurus rugosus*) a Diamond Snake (*Morelia spilotes*) from Australia, received in exchange.

OUR ASTRONOMICAL COLUMN

PHOTOGRAPHIC EVIDENCE AS TO THE CONSTITUTION OF SUNSPOTS.—M. Janssen, remarking on some exquisite photographs of sunspots which he has obtained during the past year, calls attention to the evidence they supply as to the continuation of the granulation of the general solar surface into the spots. A photograph of the great spot of 1885, June 22, for example, to which he particularly alludes, shows that the bright region which surrounds the penumbræ of large spots has not a different constitution from that of the photosphere in general, since it is made up in like manner of granular elements, usually of a spherical form. The marked increase in brightness of such regions the photographs show to be due to the granulations being more thickly clustered, brighter in themselves, and arranged on a brighter background. In the penumbra the granulations are still distinguishable, but they are less luminous and more scattered, leaving dark gaps between the rows of grains, the familiar striated appearance of the penumbra being due to the arrangement of the granulations in ranks and lines, like beads on a thread. The grains become in general smaller and duller near the nucleus, where they seem to dissolve. The same spot presented two very remarkable bridges, and a very bright isolated mass of luminous matter which united them. This luminous matter and the bridges were also formed of granular elements resembling the others. Many other photographs have revealed a similar structure in penumbræ and their surroundings, so that it is highly probable that "the luminous matter which forms the solar surface has everywhere the same constitution."

THE STRUCTURE OF THE SOLAR ENVELOPE.—A somewhat lengthy paper by M. Trouvelot, on the above subject, originally published in the *Bulletin Astronomique* for June, August, and September last, has recently appeared. The first part of the paper consists of a *résumé* of a number of striking and typical observations which are illustrated in the plate which accompanies it. These observations principally relate to spots of irregular and complicated form; the most remarkable being those in which M. Trouvelot describes the formation of numbers of bright white points over sunspots, like "a fall of snow," sometimes even obliterating them, the formation of purple vapours in connection with both spots and prominences, and the apparent changes and sometimes complete concealment of spots occasionally produced by faculæ. The essentially granular appearance of the sun, so well brought out in M. Janssen's photographs, has by no means escaped M. Trouvelot's notice, and he has even seen the lines C D_1 D_2 b_1 b_2 b_3 and F as themselves granulated, *i.e.* not uniformly dark, but composed of a great number of whitish points separated by dark intervals. The latter part of the paper is occupied with inferences as to the constitution of the solar envelope resulting from a consideration of these observations. The theory formed resembles in its essential characteristics that so admirably set forth by Prof. Young in his book on the sun. The sun is surrounded by a shell relatively very shallow, made up of innumerable vertical filaments due to the condensation of metallic vapours, and which M. Trouvelot proposes to call the *nematosphere*, in distinction to the photosphere, the glowing summits of these filaments. The behaviour of these filaments under various circumstances is discussed, and the varying effects upon them of hydrogen and metallic eruptions from the solar nucleus below of different degrees of violence is made to account for the varied phenomena of spots, faculæ, and prominences. The brilliance of the photosphere is regarded as due to the high radiating powers of these metallic vapours, when on arriving at the surface of the sun they are condensed, partly from the effect of exposure to the cold of space, and partly from expansion, the granulations being glowing clouds composed of these condensed metallic vapours, the summits of these filaments or columns.

M. Trouvelot expressly contradicts the frequently-made assertion that the bright D_3 line of the chromosphere has no counterpart amongst the dark lines of the spectrum of the disk; the line is indeed an exceedingly fine one, but it is unmistakably present.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 FEBRUARY 7-13

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on February 7

Sun rises, 7h. 30m.; souths, 12h. 14m. 22·8s.; sets, 16h. 58m.; decl. on meridian, 15° 14′ S.: Sidereal Time at Sunset, 2h. 9m.

Moon (at First Quarter on Feb. 12) rises, 8h. 47m.; souths, 14h. 39m.; sets, 20h. 41m.; decl. on meridian, 2° 12′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	7 14	11 26	15 38	20 30 S.
Venus	7 20	13 11	19 2	2 42 S.
Mars	20 4*	2 37	9 10	5 51 N.
Jupiter	21 14*	3 14	9 14	0 50 S.
Saturn	12 46	20 57	5 8*	22 41 N.

The planet Venus is now very near to inferior conjunction.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon

Feb.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
10	B.A.C. 741	6½	18 6	19 12	157 286
12	48 Tauri	6	20 40	21 40	93 347
12	γ Tauri	4	22 45	23 47	128 323
13	71 Tauri	6	1 43	2 25	95 345

Phenomena of Jupiter's Satellites

Feb.	h.	m.		Feb.	h.	m.	
7 ...	0	0	I. ecl. disap.	10 ...	2	17	III. ecl. disap.
7 ...	0	38	II. tr. egr.	10 ...	5	11	III. ecl. reap.
7 ...	3	8	I. occ. reap.	10 ...	5	40	III. occ. disap.
7 ...	22	3	I. tr. ing.	12 ...	3	43	II. ecl. disap.
8 ...	0	18	I. tr. egr.	13 ...	5	23	I. tr. ing.
8 ...	21	34	I. occ. reap.	13 ...	22	3	III. tr. egr.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, February 7. Outer major axis of outer ring = 45″·0; outer minor axis of outer ring = 20″·1; southern surface visible.

Feb.	h.	
7 ...	6 ...	Mars at greatest distance from the Sun.

Variable-Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Feb. 11,	22 19	*m*
Algol	3 0·8	40 31 N.	,, 8,	21 42	*m*
			,, 11,	18 31	*m*
λ Tauri	3 54·4	12 10 N.	,, 10,	23 51	*m*
W Virginis	13 20·2	2 47 S.	,, 8,	0 0	*M*
δ Libræ	14 54·9	8 4 S.	,, 11,	23 54	*m*
U Coronæ	15 13·6	32 4 N.	,, 13,	3 5	*m*
S Serpentis	15 16·3	14 43 N.	,, 8,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 8,	14 0	*m*
		and at intervals of	20	8	
β Lyræ	18 45·9	33 14 N.	Feb. 11,	9 30	*M*
R Lyræ	18 51·6	43 48 N.	,, 10,		*m*
δ Cephei	22 24·9	57 50 N.	,, 7,	21 30	*m*
			,, 13,	7 0	*m*

M signifies maximum; *m* minimum.

Meteors

There are no important periodical showers at this season of the year. The following are amongst the principal radiants from which meteors may be expected:—Near Capella, R.A. 75°, Decl. 44° N.; three radiants in Ursa Major, R.A. 131°, Decl. 52° N., R.A. 180°, Decl. 56° N., and R.A. 210°, Decl. 53° N.; one from Corona Borealis, R.A. 226°, Decl. 30°; near β Herculis, R.A. 260°, Decl. 0°. February 10 is a fireball date.

Stars with Remarkable Spectra

Name of Star	R.A. 1886·0 h. m. s.	Decl. 1886·0 ° ′	Type of spectrum
72 Schjellerup ...	6 3 49	26 2·1 N.	IV.
η Geminorum ...	6 8 0	22 32·4 N.	III.
μ Geminorum ...	6 16 3	22 37·5 N.	III.
78 Schjellerup ...	6 28 42	38 32·2 N.	IV.
LL 13412	6 49 12	23 46·8 S.	Bright lines
51 Geminorum ...	7 6 49	16 21·2 N.	III.
115 Schjellerup ...	8 48 57	17 39·9 N.	IV.
120 Schjellerup ...	9 3 46	31 25·7 N.	III.
R Leo Minor ...	9 38 45	35 2·1 N.	III.
R Leonis	9 41 26	11 57·5 N.	III.

BIOLOGICAL NOTES

Metamorphosis in Nematodes.—Dr. von Linstow sums up our present knowledge as follows:—The Nematelminthes, according to the medium in which the individual developmental stage is passed, present a truly wonderful series of metamorphoses, and no less than fourteen distinct developmental stages may be enumerated. (1) The embryo passes into an adult form direct (without the intervention of a larval stage) in the one medium, and also passes its existence in fresh, salt, or brackish water, in plants, in the earth, or in decaying substances (Dorylaimus, Enoplus, Plectus, Monhystera, Rhabditis, and many other genera). (2) The larvæ live in the earth, the adult form in plants (*Tylenchus tritici, T. putrefaciens, Heterodera schachtii*). (3) The larvæ live in worms, and on their death and decay pass into the earth, when they assume an adult form (*Rhabditis pellio*). (4) The Helminth lives bisexual in the earth, the fruitful females enter the bodies of bees, and produce therein offspring (*Sphærularia bombi*). (5) The larvæ live in the earth, assuming the adult condition in some animal (Dochmius, Strongylus). (6) The Helminth lives as an hermaphrodite form in some animal, the offspring develop into bisexual forms in the earth (Rhabdonema, Angiostomum). (7) Some adult forms differentiate free-living forms developing sexually, and also hermaphrodite forms living parasitically in animals (snails, *Leptodera appendiculata*). (8) The larvæ hatch out in the earth, and then enter some animal, in which they become metamorphosed into hermaphrodite forms (Trichocephalus, Oxyuris). (9) The larvæ live in insects, the adult form in earth or water (Mermis). (10) The larvæ live encapsuled in some animal, and with it pass into the digestive system of some other animal form, in which latter they become adult (Ascaris, Filaria, Cucullanius). (11) For a short time the hermaphrodite form lives in the intestine of some animal, and produces here its larval form, which, penetrating the intestinal walls, makes its way into the muscles, where it becomes encapsuled (*Trichina spiralis*). (12) The adult form lives in the tracheæ of birds; the females lay eggs, which contain well-formed embryos, which get expectorated, to once again enter the bird's system with its ordinary nourishment. In the crop and œsophagus of the bird the embryo hatches out, wandering into the bronchiæ and air-sacs, from whence the larger larvæ find their way to the tracheæ (*Syngamus trachealis*). (13) There will be two larval forms, of which the one will be found in Mollusca, and the other in aquatic beetles and water-boatmen, while the adult form lives in water (*Gordius aquaticus*). (14) There will be two larval forms, of which the one will be found in water, the other in the lung of some Amphibian, from whence it will wander into the intestine of the same animal, where it will develop into an hermaphrodite form (*Nematoxys longicauda*); this latter form is described and figured.—(*Zeitschrift für wissenschaftliche Zoologie*, November 24, 1885, Band xlii. Heft 4, p. 715, pl. 28.)

Artificial Propagation of Oysters.—Mr. W. K. Brooks calls attention in detail to a very important fact in the artificial propagation of oysters to which his notice was first called by Mr. W. Armstrong, of Hampton, Virginia. It would appear that "seed" oysters which Mr. Armstrong had placed on "floating-cars" in the mouth of Hampton Creek not only grew more rapidly, but were of a better shape, and therefore more marketable, than those from seed deposited at the same time in the usual way on the bottom. Immediately after the embryo oyster acquires its locomotor cilia there is a period of several hours, when it swims at the surface, and this is the period when it is swept into contact with collectors. As soon as the shell appears, the larva is dragged down by its weight, and settles at the bottom. The greatest danger to which it is now exposed is that it may not at this stage of its existence find a hard, clean surface for attachment. Being of microscopical dimensions, it may be smothered by a deposit of sediment or mud so light as to be invisible, and most of the failures to get a good "set of spat" are due to the formation of a coat of sediment upon the collectors *before* the young oysters come into contact with them. This danger seems to be entirely avoided by the use of floating collectors, for little sediment can fall on a body which is close to the surface of the water, and most of what may fall will be swept off by the currents which bring the swimming embryo oysters into the collectors. The collector employed by Mr. W. K. Brooks was formed by connecting two old ship-masts together by string pieces, with a bottom of coarse galvanised iron netting which had buoyancy enough to support a large quantity of submerged shells. Such floats should be open at the ends to permit free circulation, and should be so moored as to sway with the current. Mr. Brooks moored a collector, on July 4, in front of the Zoological Laboratory at Beaufort, N.C. Although all the oysters in the vicinity, from being in very shallow water, were nearly through their spawning season, and the conditions were anything but favourable, yet there was immediately secured a good "set," and the young oysters grew with remarkable rapidity, no doubt on account of the abundant supplies of food and fresh water, which gained ready access to all of them, and the uniform temperature which was secured by the constant change of water. The importance of this suggestion is obvious: this method may be used by planters to collect their own supply of seed—an object of great importance—when the feeding regions are far removed from native beds. Perhaps time will prove that it may be also used for rearing the oyster to a stage making it fit for the market; when, if so, the better shape and firmer shell would give the supply thus raised a superior value. Even in places where there are no oysters near to furnish the supply of eggs, a few spawning-oysters could be placed among the shells in the collector, after the French method, to supply the "set." Though, as Mr. W. K. Brooks says, "Engagement in business projects is no part of the [direct] office of a University," still, we venture to hold

that all advance in scientific knowledge has a bearing on the "business" life of a country, and we believe that these hints, based on the practical experience acquired at the Chesapeake Zoological Laboratory, will not be without value as showing what the man of science may do for the man of business. —(*Johns Hopkins University Circulars*, vol. v., No. 43, p. 10, Baltimore, October 1885.)

REPORT OF THE SUPERINTENDENT OF THE U.S. NAVAL OBSERVATORY[1]

WE make the following extracts from this important Report :—

Rear-Admiral S. R. Franklin, U.S.N., continued in the duties of Superintendent until March 31 of the current year, when he was detached therefrom in order to assume command of the United States naval force on the European station. In the interim from that date until June 1, 1885, Commander A. D. Brown, U.S.N., acted as Superintendent, when, under the orders of the Department, Commodore Belknap assumed the duties of the office.

The 26-inch Equatorial.—This telescope has continued in charge of Prof. A. Hall, U.S.N., who has been employed in observing the satellites of the large planets and in observation of double stars.

Though in constant use, the instrument, together with its micrometer, driving clock, and other apparatus, remains in good working order, and the dome, forty-three feet in diameter, covering it, is now revolved with great ease by means of the four horse-power gas-engine which was connected with it in the latter part of 1884. The dome is now turned to any position required in a few minutes, and the work of observing is much facilitated. Mr. George Anderson has charge of the engine, and assists Prof. Hall in the management of the dome.

The complete reduction and discussion of the observations made with this instrument have made good progress during the past year. This is due, in a great measure, to the efficient aid rendered by Lieut. W. H. Allen and Ensign J. A. Hoogewerff, U.S.N. These gentlemen have been very diligent in making the necessary computations, and have shown marked aptitude for the work.

The observations of the satellite of Neptune and those of the two outer satellites of Uranus have been discussed, and the masses of these planets deduced. These results have been published in Appendixes I. and II. of the annual volume of the Observatory for the year 1881.

A discussion of all the observations of Iapetus, the outer satellite of Saturn, is now nearly finished, and will be ready for printing in a few weeks. . . .

The Prime Vertical Instrument.—The work of reducing the observations made in 1883-84 by Lieut. C. G. Bowman and Ensign H. Taylor, U.S.N., for the determination of the constant of aberration, has been pursued. A selection was made of twelve stars of varying right ascension and well-determined places, and the results obtained ; the reduction of the remaining observations will be proceeded with as rapidly as possible.

In July of last year a communication was received from the President of the International Geodetic Conference, asking the co-operation of this Observatory with the Royal Observatory at Lisbon in the determination of the problem of the change of latitudes, the observations to be taken with the prime vertical instruments of the two Observatories. Communication was opened and correspondence is still in progress with the Director of the Observatory at Lisbon, and preparations have been made to undertake the work here very soon after it is known that it will be begun at Lisbon. . . .

Photography.—In the programme of work proposed for the current year it was stated that the work of taking sun photographs daily would be inaugurated as soon as practicable. The work of the Transit of Venus Commission has up to this time prevented any regular system being adopted. Such work, if pursued systematically and continuously, would put this institution on a footing in this regard more nearly equal to that of the larger foreign Observatories where a large mass of data has been accumulated for future measurement, computation, and discussion, forming the basis of much information of value to the student of solar physics.

For purposes of co-operation in this scientific work, photographic observations in different parts of the world being supplemental to each other, it is also desirable that this work be begun, and sooner or later it will have to be taken up here in order to keep pace with the requirements of modern astronomical research and observation. It cannot, therefore, be begun too soon.

It is eminently desirable that this Observatory possess a collection of photographs of astronomical subjects, and so be enabled to solicit exchanges from astronomers abroad that are engaged in celestial photography. But we lack the means and equipment for printing and making photographic positives that can properly be used for such purposes of exchange.

Much work is desirable to be done in photographing star clusters, nebulæ, and the spectra of sun-spots, stars, &c., and in the production of star maps by photography. Should a party from this Observatory be sent to observe the total eclipse of 1886, photographs of the phenomenon will have to be taken. The Observatory should at all times be prepared for such an occasion and have a staff drilled in photographic work, and this might be easily accomplished, as the number need not be great, and it could be made up of officers stationed here.

New Observatory.—The Commodore renews the recommendations of his predecessors for the removal, at an early day, of the plant of the Observatory to the new site selected and purchased for such purpose in 1881.

The plans, long since prepared, have received the approval of prominent scientific men of the country, and the work can be begun as soon as the money is forthcoming ; and with the funds in hand, it would take fully three years to erect the buildings, transfer the plant, and get everything into good working order.

The National Academy has been requested by the Department to express its opinion officially as to the advisability of proceeding promptly with the erection of the building, and it cannot be doubted that it will express itself affirmatively in the matter.

The disadvantages of the present location have been so often and so forcibly described that the subject is worn almost threadbare.

To the foresight and energy of officers of the Navy is due the inception and development of this institution. It is emphatically the child of the Navy, and the service is much interested in its welfare and in every effort to extend the sphere of its usefulness. From its humble beginning in 1838 it has now grown to be one of the most important astronomical centres in the world, and it is to be hoped that Congress will recognise the good work hitherto done by granting the means to place the institution on a still higher plane than it now occupies.

Board of Visitors.—The Commodore renews the suggestion heretofore made that a Board of Visitors, composed of competent persons, be appointed annually to visit the institution and inquire into its working, with authority to suggest such changes in the methods pursued, or such new lines of investigation, as it might deem proper to recommend.

Solar Eclipse of 1886.—A total eclipse of the sun will occur on August 29, 1886. The line of totality passes over the equatorial portion of the Atlantic Ocean, and reaches the west coast of Africa, near Benguela, in latitude 12° S. This port is easy of access, and as it is the healthy season, there would be no difficulty in sending a party out in a Government vessel. The duration of the totality at this point is four minutes and forty seconds, affording a more than usually good opportunity for photographic and spectroscopic observations. The question as to the propriety of applying for an appropriation to defray the expenses of an observing party has been referred by the Department to the National Academy, and a report may soon be expected.

Miscellaneous.—During the year the names of 1408 visitors have been recorded, and 1137 permits were issued for night visitors, for whose accommodation the small equatorial is set apart. The presence of these visitors is not allowed to interfere with the regular work of the institution, and permits are only issued for one evening in each week, with exceptional instances.

The records kept by the several observers and watchmen show that only about one night in eight is good for observing, while an exceptionally good night for astronomical work cannot be reckoned upon much oftener than once a month.

[1] By G. E. Belknap, Commodore U.S.N., Superintendent United States Naval Observatory. Dated Washington, October 5, 1885

MOLECULAR PHYSICS

AT the meeting of the Berlin Physical Society, on Nov. 20 last, Herr Gerstmann spoke on a work recently issued by Prof. W. C. Wittwer, on "The Principles of Molecular Physics

and Mathematical Chemistry." The main problem to which the work addressed itself respected the nature and properties of the imponderable matter, ether, but its arguments were, in the main, drawn from fancy more than from experience. The work was divided into three parts. The first part, the Constitution of Bodies, formulated the theory that the ponderable atoms were not qualitatively, but only quantitatively, distinguished from one another; that the elastic effect of matter on ether, as on ponderable substances, diminished with the distance; and that the density of the ether ranged round ponderable matter did not diminish in proportion to the distance from the mass of atoms, but increased in proportion to the distance. As essential to the constitution of the bodies was further advanced the pressure of ether on the particles of ether ranged round the ponderable atoms. The second part, the Principles of Chemistry, proceeded from the hypothesis that a material particle was capable of attracting only one, or quite few, particles of ether, acting in such a manner, namely, that a fraction of the attractive force, now of the particle of ether, now of the mass particle, was kept in abeyance (conditions which, for reasons otherwise altogether unexplained, were termed "electro-negative" and "electro-positive" respectively), and made use of an accidental property of the curve of the density of elements contained in L. Meyer's "Modern Theory of Chemistry," namely, that in the case of the maxima and minima of this curve, elements related electro-negatively to the neighbouring elements in the curve always passed over to such in which the reverse condition obtained. in order, by calculations described by the author himself as highly uncertain, to determine the molecular magnitude of some elements and the number of particles of ether attracted by their atoms. The third part, the Doctrine of Heat, propounded heat as elastic concussions; in elaborate calculations brought forward for some examples of numbers the argument that the occurrence of the stationary state was explainable under this assumption likewise; and contended against the Mariotte-Gay-Lussac and Avogadro laws, which were incapable of rightly explaining the facts, seeing that these laws and their deduction took no account whatever of the imponderable ether and the pressure of ether.

THE HISTORY OF FOSSIL CROCODILES[1]

IN this communication the author endeavoured to summarise the main facts already known regarding the palæontological history of the Crocodilia, with full references to the principal literature of the subject. After some preliminary remarks upon the structure and distribution of the living members of the order, the leading types of each geological period were successively considered; and the paper concluded by discussing the bearing of these facts upon the evolution of the Crocodilia, as determined by Prof. Huxley in 1875. The earliest crocodilians hitherto discovered are *Belodon*, *Stagonolepis*, and *Parasuchus*, from the Upper Trias—the first-named being met with on the Continent, in India, and in North America; the second, solely known from the yellow sandstones of Elgin; and the third, only recorded as yet from India. The Rhætic Beds and Lower and Middle Lias do not appear to have yielded any remains of this order, but numerous examples have been found in the Upper Lias, and some in a remarkable state of preservation. At present, however, the precise systematic relationships of the Liassic forms have not been very satisfactorily determined, and those from British deposits are especially in need of further study: there are probably two generic types, *Mystriosaurus* and *Pelagosaurus*, and, if the latest researches are to be followed, it would seem that only two species of each are definitely known. In England, according to M. Deslongchamps, two distinct forms, *Mystriosaurus chapmani* and *Pelagosaurus bronguiarti*, have been continually described under the name of *Teleosaurus chapmani*. With the Lower Oolites, *Teleosaurus* proper makes its appearance, and ranges at least as far upwards as the Kimmeridge Clay, from which Mr. J. W. Hulke has described a characteristic snout (*T. megarhinus*). *Steneosaurus* is also a Lower Oolite form, ranging to the Oxford Clay; its British representatives are somewhat imperfectly known, though very complete descriptions have been published of well-preserved cranial fossils from French deposits. *Metriorhynchus* is another genus, from the Middle and Upper Oolites, very fully elucidated by M. Deslongchamps in France, but scarcely determined hitherto in English strata. Two forms described by Prof. Phillips under the names of *Steneosaurus palpebrosus* (Kimmeridgian), and *Steneosaurus gracilis* (Portlandian) are truly referable to *Metriorhynchus*, and fragments agreeing specifically with some of the French Metriorhynchs are also recorded. The Upper Oolites also yield the remains of Crocodilia with comparatively short and stout skulls, and very complete specimens have been discovered in the Kimmeridge Clay both of England and the Continent. They belong to the genera *Dakosaurus* and *Mazhimosaurus*, the former having also been described by Sir Richard Owen under the name of *Plesiosuchus*. Teleosaurians occur rarely in the Wealden and Purbeck Beds—though one or two well-preserved crania of *Macrorhynchus* are known in Germany—and they finally disappear in the Upper Cretaceous series, where they are represented by the scanty remains of *Hyposaurus* and *Enaliosuchus*. Broad-faced crocodilians, adapted for a more terrestrial mode of life than the Teleosaurs, occur somewhat abundantly in the Wealden and Purbeck Beds, and are represented by *Goniopholis*, *Nannosuchus*, *Oweniasuchus*, *Theriosuchus*, and a remarkably interesting genus—*Bernissartia*—recently described by M. Dollo from the now classical deposit of Bernissart in Belgium. The latter, though decidedly Mesosuchian, approaches the living crocodiles and alligators much more closely than any of its congeners, both in the characters of its dermal armour and in certain parts of the skull. The earliest evidence of procœlian crocodiles hitherto made known is from the Cambridge Greensand and the nearly equivalent Gosau Beds of Vienna; Prof. H. G. Seeley has described a few vertebræ, teeth, and fragments of limb-bones, and regards these as referable to at least three specific types. The Upper Cretaceous beds of France and the United States have yielded still more satisfactory remains—including skulls—howing that the Eusuchian sub-order dates back beyond Eocene times; and some of these fossils appear almost indistinguishable from the living genus *Gavialis*. The early Tertiary deposits, both of England and the Continent, are remarkable as affording traces of gavials, crocodiles, and alligators (or alligatoroid genera) associated together, while the three families share no common area of the earth's surface at the present time; the Eocene types, moreover, appear to be rather less differentiated than is the case in the existing fauna. In conclusion, it may be said that the abundant acquisitions of fossil Crocodilia during the last ten years have fully confirmed the views of Prof. Huxley, laid before the Geological Society in 1875; and the Wealden and Purbeck discoveries, particularly, have brought to light facts which were then little more than probable surmises based upon very fragmentary materials.

[1] Abstract of a Paper read at the meeting of the Geologists' Association on December 4, 1885, by Mr. A. Smith Woodward, F.G.S., of the British Museum (Natural History).

PROFESSOR SYLVESTER'S LECTURE "ON THE METHOD OF RECIPROCANTS AS CONTAINING AN EXHAUSTIVE THEORY OF THE SINGULARITIES OF CURVES"

PROFESSOR SYLVESTER sends us the following corrections and additions to his lecture recently given in NATURE (January 7, p. 222):—

Errata

P. 223, 1st column, line 27, for "requirements" read "acquirements."

P. 224, 1st column, line 37, for *geometrical adjustment* read *numerical adjustment*.

P. 225, in the footnote, for $\frac{\eta'''}{\eta}$ read $\frac{\eta'''}{\eta'}$.

P. 226, 2nd column, line 9, p. 227, 1st column, lines 14, 20, 22, 31, 34, 44, and 2nd column, line 16 from bottom, in all thees places for τ read t, and in the last for $\tau - \tau'$ read $t - t'$.

P. 226, 2nd column, line 5,

for $\frac{dy}{dx^2}, \frac{dy}{dx^3}, \frac{dy}{dx^4}, \ldots$

read $\frac{d^2y}{dx^2}, \frac{d^3y}{dx^3}, \frac{d^4y}{dx^4}, \ldots$

P. 226, 2nd column, line 20, for "operation" read "operator."

P. 228, 1st column, line 1, for τ read t.

P. 229, in the 1st line of the footnote in the 1st column, for "generating fraction" read "fractional generating function."

P. 229, the 17th line of the footnote should be

$$\frac{4a^2}{2}\delta_b + 5ab\delta_c + 6\left(ac + \frac{b^2}{2}\right)\delta_d + 7(ad + bc)\delta_e.$$

P. 229, line 21 of footnote, for $\frac{c^2}{2}$ read $\frac{b^2}{2}$.

P. 229, the 22nd line of the footnote should be

$$4a^2\delta_b + 5(ab + ba)\delta_c + 6(ac + b^2 + ca)\delta_d + 7(ad + bc + cb + da)\delta_e + \ldots$$

P. 230, for πραγματων read πραγματων.

P. 230, 2nd column, line 10 from bottom, for "Buckkeim" read "Buchheim."

P. 231.—The greater circle has been erroneously represented as cutting the ellipse. It should pass outside it, thus—

and its centre should be indicated by an asterisk, as well as that of the smaller circle.

P. 231, Chart 5, and p. 226, the syzygy should be in both places

$$(n-1)^2\left(\frac{d\phi}{dy}\right)^3 a + n(n-1)\left\{\frac{d^2\Phi}{dx^2}\cdot\frac{d^2\Phi}{dy^2} - \left(\frac{d^2\Phi}{dxdy}\right)^2\right\}\Phi = z^2 H.$$

P. 231, Chart 2, in the last binariant Protomorph but one, for $+ 5abe$, read $- 5abe$.

Chart 6, last line but one, for $H + \Delta U$ read $H = \Delta U$.

For "Boole-Mongian" read "Boolo-Mongian" *passim*.

Those desirous of obtaining systematic information on the subject of the lecture may consult the following recent articles from the pen of its author, viz. one on "Schwarzian Derivatives," followed by another on "Reciprocants" in the *Mathematical Messenger*, four "Sur une nouvelle théorie de formes algébriques," a fifth "Sur les Invariants Différentiels," which have already appeared, and a sixth "Sur les réciprocants purs irréductibles du quatrième ordre," about to appear in the *Comptes rendus* of the Institute.

It may be as well to mention that the papers in the *Messenger* were given in long after the dates which the numbers of the *Messenger* bear on their cover, those dates being by some months anterior to the time of their actual issue. In the absence of this explanation the theory would appear to have been in print long before the time when it is stated to have been discovered.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Prof. Stirling succeeds Dr. Gamgee as an examiner in the Honour School of Natural Science, not Prof. Burdon-Sanderson, as stated last week.

CAMBRIDGE.—Mr. A. E. Shipley, B.A., Scholar of Christ's College, has been appointed Demonstrator of Comparative Anatomy. Mr. Shipley was placed in the first class in the Natural Sciences Tripos Part II., for Zoology and Comparative Anatomy.

It is recommended by the Council of the Senate that the University should now take over the machinery and other plant of the Engineering School belonging to Prof. Stuart. In 1883 its value was estimated at 2500*l*. It has since been considerably added to. Out of the receipts from students' fees and for payments for work done for University departments nd private persons, the machinery has been kept in good repair, 10 per cent. has been set aside each year for depreciation, and 5 per cent. has been paid upon the capital, and in addition a profit of 100*l*. was made last year.

SCIENTIFIC SERIALS

The American Journal of Science, January 1886.—Observations on invisible heat-spectra and the recognition of hitherto unmeasured wave-lengths made at the Alleghany Observatory, by S. P. Langley. It is agreed that all cold bodies must not only radiate heat to still colder bodies, but, according to our present conception of radiant energy, be also capable of giving a spectrum, whether we can recognise it or not. The object of the present paper is to describe the actual formation of such spectra and the recognition of their heat in approximate terms of wave-lengths. From the author's researches it is inferred that some of the heat radiated by the soil has a probable wave-length of over 150,000 of Ångström's scale, or about twenty times the wave-length of the lowest visible line in the solar spectrum as known to Fraunhofer.—Botanical necrology of 1885, by Asa Gray. Obituary notices are here given of Charles Wright, of Wethersfield, Connecticut (1811-1885); George W. Clinton, of Albany, New York (1807-1885); Edmond Boissier, of Geneva (1810-1885); and Johannes August Christian Roeper, of Basle (1801-1885).—The isodynamic surfaces of the compound pendulum, by Francis E. Nipher. It is generally assumed that particles near and below the axis of suspension are retarded, and those near the bottom of the pendulum accelerated, by reason of their connection with the system, while the series of particles forming the axis of oscillation are neither accelerated nor retarded. But although this may be true as regards the time of a complete oscillation, it is shown that in any compound pendulum the particles near the bottom do not exert a constant retarding effect upon the system.—The peridotites of the "Cortlandt Series" on the Hudson River, near Peekskill, New York, by George H. Williams. In his paper the author gives a petrographical description of the most basic members of that most interesting group of massive rocks which occurs on the southern flank of the archæan highlands about forty miles north of the city of New York.—Description of a meteorite from Green County, Tennessee, by Wm. P. Blake. This mass of meteoric iron, which was found by a farmer ploughing his field in 1876, and is now in the writer's collection, weighs 290 pounds, is of the shape of a flattened cigar, 36 inches long, 10 broad, and 6 thick. It clearly belongs to the class of exfoliating deliquescent irons, several examples of which have been found in Tennessee, Georgia, and North Carolina. A quantitative determination of a small slice from one end by Baumhauer's method gave iron 91·421, nickel 7·955.—Tendril movements in *Cucurbita maxima* and *C. Pepo*, by D. P. Penhallow. In his paper, which is not concluded, are contained the results of a study made some years ago on the movements of the squash tendrils and terminal bud. Subsequent discoveries touching the continuity of protoplasm have served to give a clue to certain phenomena observed during the researches, but which at the time could not be satisfactorily accounted for. This clue was followed up during last summer, with the result that the true explanation of the tendril movement in *Cucurbita*, and possibly also in the whole family of *Cucurbitaceæ*, appears to have been reached from histological research.

Bulletin de l'Académie Royale de Belgique, November 1885.—Solution of Wrouski's universal problem, and of another problem relating to the integration of differential equations, by Ch. Lagrange. This is the fifth memoir devoted by the author to the elucidation and correction of Wrouski's writings. Here he demonstrates and generalises for any number of variables, the following theorem: Given a differential equation of any order n:

$$\phi\left(\frac{d^n x}{dt^n}, \frac{d^{n-1}x}{dt^{n-1}}, \ldots \frac{dx}{dt}, x, t, a\right) = 0,$$

between the dependent variable x and the independent variable t (a being a parameter), an equation which may be integrated for $a=0$, the coefficients of the development of x according to the powers of a are absolutely known functions of t given by simple quadratures.—Researches on the spawning of the toad (*Bufo vulgaris*), and on the protecting layers of the egg in the batrachian family generally, by M. Héron-Royer.—Note on the origin of diastase and on the reduction of the nitrates to nitrites, by M. Ed. Jorissen. The author's experiments tend to confirm the views of Traube and Pfeffer, who regard the physiological character of the Bacteria and of the Mycetæ in general as profoundly different from that both of plants and animals. He further endeavours to show that the reduction of nitrates to nitrites by germinating grains must be attributed to the presence of the Bacteria of putrefaction in the surrounding fluid.—Experimental researches on the influence of magnetism on polarisation in the dielectrics, by Edmond van Aubel. The object of these researches is to ascertain whether it be possible to establish a parallelism between the electro-magnetic rotation of the plane of polarisation of light, the phenomena of the reflection of light on a magnet, and Hall's discovery. But the result so far has been unsatisfactory.—Note on the late Gen. Baeyer's views regarding an annual oscillation in the level of the Baltic Sea, by Gen. Liagre. Even admitting the accuracy of the observations

tending to show that in the Baltic the tides rise higher in summer than in winter, the author is disposed to attribute the phenomenon rather to local physical causes than to Baeyer's astronomic theory of solar action.—Note on the geological formation of the Juan Fernandez islands, by A. L. Renard. The prevailing rocks throughout this group would appear to be mainly basaltic, with little or no trace of lavas or other recent eruptive matter.—On some new groups of fossil remains from the Upper Chalk and Lower Eocene Tertiary formations of Belgium, by Ed. Dupont. These specimens, now mounted in the Brussels Museum of Natural History, include fragments of a Dinosaurian (*Orthomerus dollovi*) from the Maestricht district; the head and various bones of the gigantic *Mosasaurus camperi*, from Limbourg and Montague Sainte-Pierre; remains of a new type of Mosasaurian recently described by M. Dollo under the name of *Pliopiaticarpus marshi*, from Maestricht; remains of another Mosasaurian from Ciply, new in Europe, but well known in America, which M. Dollo has named *Polygonodon ciplyensis*; the carapaces of two large turtles from Maestricht, *Chelonia hoffmanni*, Gray, and *Ch. suyderbuycki*, Ubags; lastly, the skull of a crocodile affiliated by Dollo to the *Crocodilus affinis* discovered by Marsh in the Eocene of the far west.—Note on the whale captured last May off Fécamp, by P. J. van Beneden. At first supposed to be a *Balænoptera musculus*, L., or else a new species, the author shows that this cetacean is the *Balænoptera rostrata*, Fabricius, a specimen of which was taken in 1878 near Villefranche in the Mediterranean.—A study of François Huet and his philosophic writings, by O. Merten.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 7.—"Contributions to the Anatomy of the Central Nervous System of the Plagiostomata." By Alfred Sanders, M.R.C.S., F.L.S. Communicated by Dr. Günther, F.R.S. (Abstract.)

After referring to the literature of the subject, and describing the macroscopic aspect of the brain, and partly the distribution of the cranial nerves, the author proceeds to give an account of the histology of the segments of the brain.

The olfactory lobes are well developed. They present three layers. Internally cells of the smallest category are found; they give off several processes which join a network penetrating the whole layer; through the medium of this network these cells communicate with the glomeruli which form the middle layer. These glomeruli are much better developed than in the Teleostei; here they present a central core of closely intertwined fibrillæ inclosed externally by fibrils of a larger size, in the course of which cells are developed; these are arranged parallel to the long axes of the glomeruli, and join the external layer, which consists of fibres passing from the anterior end of the olfactory lobe to supply the olfactory organ.

In the Rays these lobes are solid, but in the Scyllium, Rhina, and Acanthias they contain a ventricle which communicates through a long peduncle with the ventricles of the cerebrum.

The cerebrum presents externally a layer of neuroglia without cells, or at least with comparatively few; the remainder of the parenchyma presents cells of a medium size which are usually distributed in groups with neuroglia interspersed between them; these groups in Scyllium contain from nine to fifteen cells, in the Rays generally more. Four special groups of cells occur towards the base of the brain, two in the outer and two in the inner walls: from the former arise the anterior commissure, and from the latter the crura cerebri.

Two ventricles occur in the cerebrum of Scyllium, Rhina, and Acanthias which homologise with the lateral ventricles in the cerebrum of Mammalia. At the posterior part they coalesce into one chamber which is in communication with the third ventricle; this chamber is evidently the foramen of Monro. Dr. Wilder is of opinion that the ventricles of the olfactory lobes represent the lateral ventricles, and that their apertures of communication with the above-mentioned chambers homologise with the foramina Monroi. A consideration of the case renders this idea improbable. In the Rays the ventricles are reduced to a very small chamber occupying the posterior end of the cerebrum.

The crura cerebri form two projecting walls of a gutter-shaped passage which communicates with the third ventricle. As Prof. Owen has already pointed out, they probably homologise with the nervous cords which connect the supra- with the infra-œsophageal ganglia in Invertebrata; and it is through the third ventricle that the œsophagus of the probable invertebrate ancestor of the Vertebrata could have reached the present dorsal surface without breaking through nervous tissue; for dorsally the choroid plexus and pineal gland cover in this ventricle, there being no nervous tissue here, and inferiorly it communicates through a chamber in the hypoarium with a chamber in the centre of the pituitary body; the endothelium lining the former being continuous with the endothelium lining of the latter.

The optic lobe which arches over the aqueduct of Sylvius corresponds to the tectum lobi optici of the Teleostei; the structure is much simpler, although comparatively speaking the lobe is larger. Externally it is occupied by the fibres of origin of the optic nerve; within these a transverse commissure is visible homologising with the transverse commissure in the tectum lobi optici of Teleostei. Internally a ganglion of large cells occurs variously arranged in the different species; these cells are of large size, but differ from the cells of the ventral horn of grey matter of the cord in texture, and in the fact of giving off only one process as a rule, which process runs into the above-mentioned transverse commissure. Numerous cells of small size, many of which are fusiform, occur in this lobe; these are more numerous in the centre.

The author's researches do not bear out the statement of Rohon that the thalamencephalon projects backward and covers the mesencephalon in the optic lobe; so that according to this author it is composed of both these segments of the brain. Apart from embryological considerations, which give no countenance to this idea, there is nothing in the structure of this lobe which indicates an origin from two distinct primary vesicles of the brain; on the contrary, its structure is homogeneous.

The cerebellum presents a structure corresponding to that in the Teleostei. There are, counting from within outward, the granular, fibrous, Purkinje cells, and molecular layers. The differences consist in the greater number of processes given off by the Purkinje cells, and in the greater number of small cells found in the molecular layer. Another difference is found in the presence of a ventricle which is largest in Rhina, Acanthias, and Scyllium, and reduced to very small dimensions in the Raja.

The molecular layer is continued down on to the surface of the medulla oblongata from the cerebellum, forming the restiform bodies. In the spinal cord there are distinguishable three columns on each side: a dorsal above the dorsal cornu, a lateral at the side, and a ventral beneath; the latter consists of fibres of a larger calibre than those constituting the other columns, but no gigantic fibres—the so-called Mauthner's fibres—are present, as in the Teleostei.

The deep origins of the cranial nerves. The optic nerve arises as above-mentioned from the outer half or more of the optic lobes, also by a few fibres from the hypoarium. This fact was contradicted by Bellonci in reference to the origin of this nerve in Teleostei, but further researches and consideration compel the author to adhere to his original statement.

The oculomotor arises from a ganglion in the floor of the aqueduct of Sylvius. There is no decussation of the fibres of origin of this nerve as is stated by some authors; the error probably arose from the presence in this region of a decussation of fibres derived from the transverse commissure in the optic lobe: this decussation of fibres corresponds to the commissura ansulata in Teleostei.

The facial arises from a small bundle of fibres which comes forward from the lateral columns of the cord, and is situated at the side of and slightly above the central canal.

The trifacial arises from a tuberosity overhanging the fourth ventricle immediately contiguous to the restiform bodies, also from the grey matter of the floor of that ventricle.

The vagus arises from a series of rounded tubercles which occupy the lateral portions of the floor of the fourth ventricle.

Linnean Society, January 21.—W. Carruthers, F.R.S., Vice-President, in the chair.—Mr. Harry Veitch exhibited, in illustration of Dr. Masters's paper, a series of living conifers, among which were: *Abies Fortunei*, *A. nobilis*, *A. grandis*, and *A. amabilis*; also *Pseudolaryx Kæmpferi*, *Picea Omorika*, *Pinus Pencëi*, *Arthrotaxis selaginoides*, and others.—Mr. E. M. Holmes exhibited a specimen of the ergot of Diss (*Arundo tenax*) from Algeria. This ergot is said to be more active medicinally than that of Rye, and is slenderer and twice or thrice its length, and is attributable to the fungus *Claviceps purpurea*.—Dr. C. Cogswell drew attention to dried specimens of the species of maples (*Acer*) of Canada collected by him in Nova Scotia, and of *Sisy-*

rhynchum Bermudianum and *Bryophyllum calycinum* from Bermuda. He contrasted the great difference of climate and vegetation of the continent and island, observing that the Gulf Stream doubtless had an important influence on the Bermudan flora; moreover, it was notable that Bryophyllum, like the maples, put on a brilliant red autumnal tint.—There was exhibited for M. Buysman examples of Rudbeckia and Lupinus prepared as teaching specimens of medicinal plants.—Dr. Maxwell Masters read a paper, contributions to the history of certain conifers. This comprised the result of observations on the mode of growth and structure of various species of Coniferæ, concerning which much difference of opinion had previously existed owing to the imperfection of our knowledge. Of late years many of these species had been introduced into cultivation and some of them had produced male flowers and cones, thus affording an opportunity for diagnosing the species and ascertaining their limitations. The study of the cultivated plants had likewise shown the natural range of variation in a species or individual plant under comparatively uniform conditions. Our knowledge of their geographical distribution has also been extended, altogether thus enabling a fresh revision to be attempted.—Dr. T. Spencer Cobbold read a paper on *Strongylus axei*, and its affinities. This diminutive maw-worm, obtained from the stomach of a donkey, possesses interest, inasmuch as its structural characters closely correspond with those of the entozoon infesting the ostrich's proventriculus. It also shows affinity with the grouse strongyle and with the stomach-worm of lambs; while its peculiarities throw light upon other questions of morphology, especially its relations to the singular maw-worm (Simondsia) of the hog.—In exhibiting an extensive series of fossil plants from the Island of Mull, Mr. J. Starkie Gardner gave remarks concerning inferences to be drawn from the well-preserved leaves. He mentioned that this fossil Mull flora comprises but one fern undistinguishable from living *Onoclea sensibilis* of Western America and Eastern Asia. There is an Equisetum. The Coniferæ are abundant; a *Ginkgo* resembles existing species, along with numerous firs and larches, a few of these latter being similar to those of Japan. Monocotyledons are represented by one having a sword-shaped leaf. There are at least twenty species of dicotyledons. A *Platanus* obtains, differing somewhat from the recent form, and with resemblances to what is known as *Credneria* and *Protophyllum* of Cretaceous age. This Mull flora, though possessing few novelties, is interesting as supplying fresh confirmation of the view first propounded by Asa Gray—that formerly the entire northern temperate regions possessed a very uniform flora.

Anthropological Institute, January 12.—Mr. Francis Galton, F.R.S., President, in the chair.—The election of Mrs. C. Brooke (H.H. the Ranee of Sarawak) was announced.—Mr. Bryce-Wright exhibited a bronze sword, of the leaf pattern, found by the late Capt. Sir William Peel, R.N., at Sandy, Bedfordshire.—A collection of flint implements from the junction of the Thames and Wandle was exhibited by Mr. G. F. Lawrence.—Dr. R. Munro read a paper on the archæological importance of ancient British lake-dwellings and their relation to analogous remains in Europe. The lake-dwellings of Scotland were essentially the product of Celtic genius, and were constructed for defensive purposes. Dr. Munro believes that those in the south-west parts of the country attained their greatest development in post-Roman times, after Roman protection was withdrawn from the provincial inhabitants, and they were left to contend single-handed against the Angles on the east and the Picts and Scots on the north. He suggested the theory that the British Celts were an offshoot of the founders of the Swiss lake-dwellings, who emigrated into Britain when these lacustrine abodes were in full vogue, and so retained a knowledge of the custom long after it had fallen into desuetude in Europe. Amongst other arguments in support of this hypothesis, Dr. Munro pointed out that the geographical distribution of the lake-dwellings in Europe closely corresponds with the area formerly occupied by the Celts, and that they are identical in structure with the crannogs.—In a paper on three stone circles in Cumberland, Mr. A. L. Lewis showed that in these circles, as in others previously described by him, there is a marked preponderance of outlying stones and prominent hills towards the north-east, and that the circle-builders followed the Babylonians rather than the Egyptians in their rules of orientation. In the relation between stone circles and adjacent hills and outlying stones, suggestions might be found not only of sun-worship, but also of mountain-worship and of phallic worship.

Royal Meteorological Society, January 20.—Mr. R. H. Scott, F.R.S., President, in the chair.—The Secretary read the report of the Council, which stated that the past year had been one of great activity, as the eight Committees which had been appointed had met frequently, and had done much for the advancement of meteorology. The number of Fellows on the roll of the Society is 537.—The President in his address said that, as he had treated of land climatology in his previous address, he proposed to deal with marine climatology on the present occasion, and to take up the subject at the point where he had left it in his paper, "Remarks on the Present Condition of Maritime Meteorology," printed in the Society's *Quarterly Journal* for 1876. He enumerated the various investigations which had been announced to be in progress at that date, and specified the several outcomes of these inquiries which had seen the light during the ten years. The "Meteorological Charts for the Ocean District adjacent to the Cape of Good Hope," published by the Meteorological Office in 1882, were first noticed, and the methods of "weighting" observations of wind, &c., employed in that discussion were fully explained, as well as the mode of representation of barometrical results. The "Charts showing the Surface Temperature of the Atlantic, Indian, and Pacific Oceans," published in 1884, and those of barometrical pressure, now in the engraver's hands, were next noticed; and it was announced that the Meteorological Council had decided to undertake the issue of monthly current charts for the entire sea-surface. The wind charts published by the late Lieut. Brault, of the French Navy, were next described, with an expression of the profound regret with which the intelligence of his premature death in August last had been received by all meteorologists. The wind charts and pressure tables issued by the Meteorological Institute of the Netherlands were then explained, and also the publications of the Deutsche Seewarte at Hamburg, "The Atlas of the Atlantic Ocean," &c. The series of "Monthly Charts for the Atlantic and Pacific Oceans" issued by the Hydrographic Office, Washington, were then described, and the present series of "Pilot Charts" issued by the same office were explained. As for projected work in 1886, Mr. Scott stated that the daily maps of Atlantic weather for the year of the circumpolar expeditions were now complete, and were being engraved, a process which must take several months. The German Office had undertaken the preparation of daily weather maps for the same period for the South Atlantic. The Meteorological Office had also taken up the marine meteorology of the Red Sea. The Dutch Institute had announced its intention to publish an atlas for the Indian Ocean. In conclusion Mr. Scott stated that there still existed a lamentable want of data for the Pacific Ocean, but that, thanks to the energy of the Canadian Government in opening up their new Pacific Railroad, it was to be hoped that every year would bring a greater amount of traffic to British ports on the Pacific Coast, and therefore a greater number of observations to the Meteorological Office, while from the existing trade to San Francisco a mass of materials was quickly accumulating for certain routes at least over the vast area of the Pacific.—The following gentlemen were elected the Officers and Council for the ensuing year:—President: William Ellis, F.R.A.S.; Vice-Presidents: George Chatterton, M.Inst.C.E., Edward Mawley, F.R.H.S., George Mathews Whipple, F.R.A.S., Charles Theodore Williams, M.D., F.R.C.P.; Treasurer: Henry Perigal, F.R.A.S.; Trustees: Hon. Francis Albert Rollo Russell, Stephen William Silver, F.R.G.S.; Secretaries: George James Symons, F.R.S.; John William Tripe, M.D.; Foreign Secretary: Robert Henry Scott, F.R.S.; Council: Edmund Douglas Archibald, William Morris Beaufort, F.R.A.S., Arthur Brewin, Frederic William Cory, M.R.C.S., Henry Storks Eaton, Charles Harding, Richard Inwards, F.R.A.S., Baldwin Latham, F.G.S., John Knox Laughton, F.R.G.S., William Marcet, M.D., F.R.S., Cuthbert Edgar Peek, F.R.A.S., Capt. Henry Toynbee, F.R.A.S.

Physical Society, January 23.—Prof. Guthrie, President, in the chair.—The following communications were read:—A note on the paper by Prof. W. Ramsay and Dr. S. Young on some thermodynamical relations, by Prof. W. E. Ayrton and Prof. John Perry. The authors, after referring in the highest terms to the careful experimental work of Messrs. Ramsay and Young in their investigation upon "some thermodynamical relations," the results of which were communicated to the Society at its last meeting, show that the four laws stated in their paper are in reality only one, since if any one of them is assumed the remaining three may be deduced from it. Hence it is sufficient

to examine only one, and of the four the third is in the form that can be most readily tested. This law, the statement of which is, that for all substances at any given pressure the product $t\frac{dp}{dt}$ is constant, p being the pressure, and t the absolute temperature of saturated vapour at that pressure, is represented mathematically thus—

$$t\frac{dp}{dt} = \phi(p) \quad \ldots\ldots\ldots \quad (1)$$

$\phi(p)$ being a function of the pressure, independent of the substance. Writing this equation

$$\frac{dp}{\phi(p)} = \frac{dt}{t}$$

and integrating, we get

$$t = a\psi(p) \quad \ldots\ldots\ldots \quad (2)$$

$\psi(p)$ being also a function of the pressure only, and a a constant depending only upon the substance employed. It is in this form that the authors have examined the third law; if true, it follows at once from (2) that the ratio of the temperatures of two saturated vapours to one another at any pressure is the same as the ratio at any other pressure. It is seen, however, either by reference to Regnault's numbers, or Rankine's formula—

$$\log p = a - \frac{\beta}{t} - \frac{\gamma}{t^2} - \ldots$$

an expression based upon his molecular theory, and which, as remarked by one of the authors at the last meeting, agrees with Regnault's results with remarkable closeness, that this ratio is far from constant. The authors are therefore compelled to conclude that the expressions given by Prof. Ramsay and Dr. Young must not be regarded as absolute laws.—A note on the paper by Prof. J. W. Clarke on the determination of the heat-capacity of a thermometer, by Mr. A. W. Clayden. The author has applied a correction to an expression given by the late Prof. J. W. Clarke for measuring the heat-capacity of a thermometer, in a paper communicated to the Society at a previous meeting (April 25, 1885). Prof. Clarke's expression was affected by the mercury not entirely filling the bulb and stem of the thermometer. The corrected expression obtained by the author is

$$V_1 = \frac{V(s - s_2)}{s_1 - \frac{s_2(1 + \beta)}{1 + \alpha t}}$$

s, s_1, and s_2 being the mean densities of the instrument, mercury, and glass respectively, β and α the coefficients of voluminal expansion of mercury and glass, V and V_1 the volumes of the instrument and of the mercury.—Note on some organic substances of high refractive power, by Mr. H. G. Madan. In the course of some correspondence respecting M. Bertrand's polarising prisms, the author was informed that the cement used was napthyl-phenyl-ketone dibromide. He has consequently prepared specimens of the ketone, and subjected them to optical examination. The ketone is a thick yellow oil, boiling at a temperature near the boiling-point of mercury; it appears to be a very stable, neutral, and harmless substance like Canada balsam, but unfortunately it does not appear to be capable of hardening, and hence is not by itself adapted for a cement. Its refractive index for the D line is 1·666, higher than that of carbonic sulphide, while its dispersive power is approximately the same as that of that substance. The author has made the bromide of the ketone referred to above, but it seems liable to decompose with formation of hydrobromic acid, which acts upon the spar. Mr. Madan also exhibited a specimen of metacinnamene, a highly refracting glass-like solid obtained by the action of light or heat upon cinnamene. This substance possesses a refractive index of 1·593 for the D line, and would make a valuable cement if it showed a firm adhesiveness for glass.—The President exhibited and described an instrument he had made in the course of an acoustical investigation upon which he had been engaged. It is a musical instrument similar in principle to the harmonicon. In the case of the harmonicon the rectangular plate is usually supported by strings passing through the nodes, but the author wished to make an instrument that could be "bowed." The "nodes" are not absolute positions of rest, the particles at them describing curves having cusps pointing outwards. The plan adopted was to solder two springs to the plate, which was of brass, the points of attachment being slightly outside the nodes, and the springs being such as to give the same fundamental note as the plate. The other ends of the springs were attached to the mouth of a resonator whose fundamental note was also that of the plate. The plate when struck or bowed gave a tone very like that of a tuning-fork, and in a discussion that followed, Prof. S. P. Thompson suggested the possible use of these instruments as a substitute for a series of forks the cost of a complete set of which often places them beyond the reach of the student. Prof. McLeod suggested that the springs should be tuned to the octave of the plate instead of to its fundamental, and that they should have a slightly different form.

Edinburgh

Royal Physical Society, January 20.—Prof. Turner, F.R.S., President, in the chair.—Obituary notice of the late Dr. Carpenter, by Prof. Ewart.—The President read a paper on the occurrence of the bottle-nosed whale (*Hyperoodon rostratus*) in the Scottish seas. After a review of the history of this whale, Prof. Turner proceeded to describe several specimens which had come under his observation, more especially a young male, caught at Dunbar in November 1885. He then compared the external characters of Hyperoodon, Mesoplodon, Ziphius. A detailed description of the rudimentary teeth in the upper and lower jaws of Hyperoodon was also given, and the periods of the year when this animal migrated southwards and northwards were referred to.—Mr. Brook read a paper on the relation of yolk to blastoderm in fish-ova. The author endeavoured to show that the function of the cortical protoplasm surrounding the yolk (the parablast) is primarily a digestive one. The existence of this layer is a necessary consequence of the separation of yolk from protoplasm in meroblastic ova. The material thus elaborated in the parablast is undoubtedly budded off in the form of cells. It has been asserted by Hoffmann and others that these take no part in the formation of the embryo, but are used up in the temporary circulatory system around the vitellus. In the herring, cod, Trachinus, and probably the whole group of pelagic ova, there is, however, no trace of a vitelline circulation, yet cells are produced in the parablast of these forms in the same manner as in the trout. There thus appears no alternative but that the cells must take part in the formation of the embryo. It was therefore argued that, from a consideration of the physiological function of the parablast, the morphological value of this layer is more important than has been hitherto admitted.—A note was communicated from Mr. Dendy, on an abnormal specimen of Comatula (which had twelve arms) from the Firth of Clyde; Mr. Raeburn read extracts from his journal on the birds of the Shetland Islands; and Mr. Muirhead exhibited a specimen of the Glossy Ibis (*Ibis fascinellus*) shot last September on the borders of Roxburghshire, and a Garganey shot last February in Berwickshire.

Dublin

Royal Society, December 16, 1885.—Physical, Experimental, and Applied Science Sections.—Sir Robert W. Jackson, C.B., in the chair.—On the description by points of the principal caustics of a circle, by G. Johnstone Stoney, D.Sc., F.R.S.—Meteors and meteorites, by W. H. S. Monck, M.A.—On the fog-penetrating power of the double quadriform burner, by Prof. W. F. Barrett. The author described the results of some experiments recently made to test the illuminating power of Mr. Wigham's latest adaptation of gas to lighthouse illumination. The double quadriform burner consists of a series of four superposed 88-jet gas-burners placed alongside of four similar superposed burners. The eight burners are in one plane, parallel to which, and at the proper focal distance, are placed eight annular lenses on one side, and a similar set of lenses on the other side. The lights blend into one at a distance of about 1500 feet from the lighthouse. Experiments were made on two evenings, both of which were foggy. On the second evening the fog was so dense that a powerful revolving light less than half the distance of the double quadriform was entirely cut off, and the sound of a large fog-siren, driven by a gas-engine and placed alongside the experimental light, was also extinguished by the fog; nevertheless, on both occasions the double quadriform was easily seen by the naked eye, and its position readily determined, at six miles' distance. The author expressed his unqualified satisfaction at the result of his observation, and hoped that the authorities at Trinity House would be induced to come to Dublin and judge for themselves of the merit of Mr. Wigham's invention.

Section of Natural Science.—V. Ball, M.A., F.R.S., in the chair.—Note on the deposit of supposed worked flint implements at Thenay, near Blois, by Prof. J. P. O'Reilly, C.E.—On the occurrence of a tract of Old Red sandstone and Conglomerate amongst the Knockalla Hills, co. Donegal, by Prof. E. Hull, LL.D., F.R.S.—On a Clogg almanac in the Science and Art Museum, by B. H. Mullen, B.A.—Prof. Haddon exhibited models made by Krantz, illustrating the evolution of the shells of fossil Cephalopoda.—Mr. Greenwood Pain exhibited a remarkable fungus-growth on paper.—Mr. V. Ball exhibited a specimen of meteoric iron from Glorieta Mountain, New Mexico.

PARIS

Academy of Sciences, January 25.—M. Jurien de la Gravière, President, in the chair.—Remarks in connection with a heliographic engraving representing the aërostatic experiments at Chalais-Meudon presented to the Academy by M. J. Janssen.—Studies on a phanerogamous plant (*Cymodoceites parisiensis*) belonging to the order of the Naiadeæ, which flourished in the marine waters during the Eocene epoch, by M. Ed. Bureau. This new genus, which is named Cymodoceites, in consequence of its numerous points of analogy with the genus Cymodocea, was widely diffused over the Paris basin, and tends to confirm the Indian affinities of the Middle Eocene flora already revealed by Ottelia, Nipadites, *Nerium parisiense*, &c.—Description of a differential sphygmograph invented for the purpose of easily demonstrating the peculiar veinous circulation "by influence" discovered in 1875, by M. Ch. Ozanam.—Further observations and studies on the parthenogenetic reproduction of the Phylloxera of the vine, by M. P. Boiteau. The fifteenth generation, obtained during the year 1884 by cultivation in tubes, was increased by a new series of four generations in 1885. All are at present hibernating, and appear to show no symptoms of degeneracy. Nevertheless the Phylloxera, after a prolonged existence, will probably become less vigorous, and, like the oïdium, anthracnose, and mildew, may cease to be destructive to the plants which it infests.—Note on the comet recently discovered by M. Fabry at the Paris Observatory, by M. Weiss.—Orbit and ephemeris of Fabry's comet, calculated by M. Lebœuf. The elements of the orbit deduced from observations made at Paris on December 1 and January 10 are as under :—

T = 1886 April 6, 1372, Paris Mean Time

$$\left.\begin{aligned} \omega &= 126^\circ\ 30'\ 48''\cdot0 \\ \Omega &= 36\ 23\ 29\cdot1 \\ i &= 82\ 46\ 5\cdot5 \end{aligned}\right\} \text{Mean Equinox of 1886·0.}$$
$$\log q = 9\cdot808992$$

—Determination of the error of the constant of astronomical refraction by meridian observations, by M. A. Gaillot.—Note on the residuums of the double integrals, by M. H. Poincaré.—On the theory of linear equations, by M. E. Goursat.—Note on telemicrophonic instruments, by M. E. Mercadier. By telemicrophone the author understands a combined apparatus simultaneously producing the effects of the microphone and telephone, and reversible like the latter. He has constructed instruments of this kind, for which he claims the following advantages over the ordinary microphone : the possibility of a double mode of transmission with the same apparatus ; reversibility of the transmitter, whereby the reception is greatly simplified ; reduction of the number of organs on the microphonic posts, and consequent diminution of the total resistance of the apparatus on the same line. By this reduction the construction of the instrument may also be simplified, and its size considerably reduced.—Observations in connection with Prof. Langley's recent note on the hitherto recognised wave-lengths of light and sound, by M. Henri Becquerel. The statement attributed to the author by Prof. Langley that the most extreme radiations whose existence has been experimentally determined, do not reach a wave-length of 0·0015 mm., is denied, because the limit of observation depends essentially on the nature and delicacy of the methods employed to reveal the presence of ultra-red invisible rays.—On the transmission of copper through a volume of gas, and on the direct combination of copper with nitrogen, by M. R. Blondlot.—On some properties of the sulphur of antimony, by M. A. Ditte.—On a reagent, by means of which it may be possible to detect the acid function of the weak acids, by M. R. Engel.—On the composition of brandies distilled from wine, by M. Ch. Ordonneau. In order to ascertain the cause of the difference between neutral spirits distilled from grain, beet, potatoes, &c., and true wine brandies, the author has made a series of analyses, from which it appears that the unmistakable flavour of the latter is due to the presence in small quantities of a terpene boiling at 178° C., and whose products of oxidation are characteristic of old brandies.—On the digestive apparatus of the Phylloxera (*Ph. punctata*), by M. Victor Lemoine.—Note on the comparative morphology of the labium in the Hymenoptera, by M. Joannes Chatin.—Zoological and anatomical observations on a new species of Balanoglossus (*B. sarniensis*), discovered in the month of August 1885 at the island of Herm, a little east of Guernsey, by M. R. Kœhler.—Note on the roots of the Calamodendreæ (*Calamodendron striatum, C. congenium*, &c.), by M. B. Renault.—On the pollinic tube and its physiological *rôle* ; a new reaction of the deposits improperly called cellulose knots, by M. Ch. Degagny.

BOOKS AND PAMPHLETS RECEIVED

"The Pictorial Arts of Japan," part i. section 1, General History : Wm. Anderson (S. Low and Co.).—"Calendar of University College of South Wales and Monmouthshire," 3rd Session, 1885 and 1886 (Owen, Cardiff).—"Proceedings and Transactions of the Royal Society of Canada for the Year 1884," vol. ii. (Dawson, Montreal).—"Elements of Chemical Physics," 4th Edition : J. P. Cooke, Jun. (Macmillan and Co.).—"A Text-Book of Deductive Logic," 2nd Edition : P. K. Ray (Macmillan and Co.).—"The Year-Book of Treatment for 1885" (Cassell).—"Dogs in Health and Disease" : J. S. Hurndall (R. Gould).—"Modern Science" : Edward Carpenter (Heywood).—"Chemistry of the Non-Metallics" : Dr. E. B. Aveling (Hughes).—"The Reign of Law in Medicine" : Dr. Dyce Brown (Trübner).—"University of Wales Calendar, 1885-86" (Cornish, Manchester).

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